World Petroleum

SIXTH ANNUAL CANADIAN REVIEW NUMBER • MAY 1955

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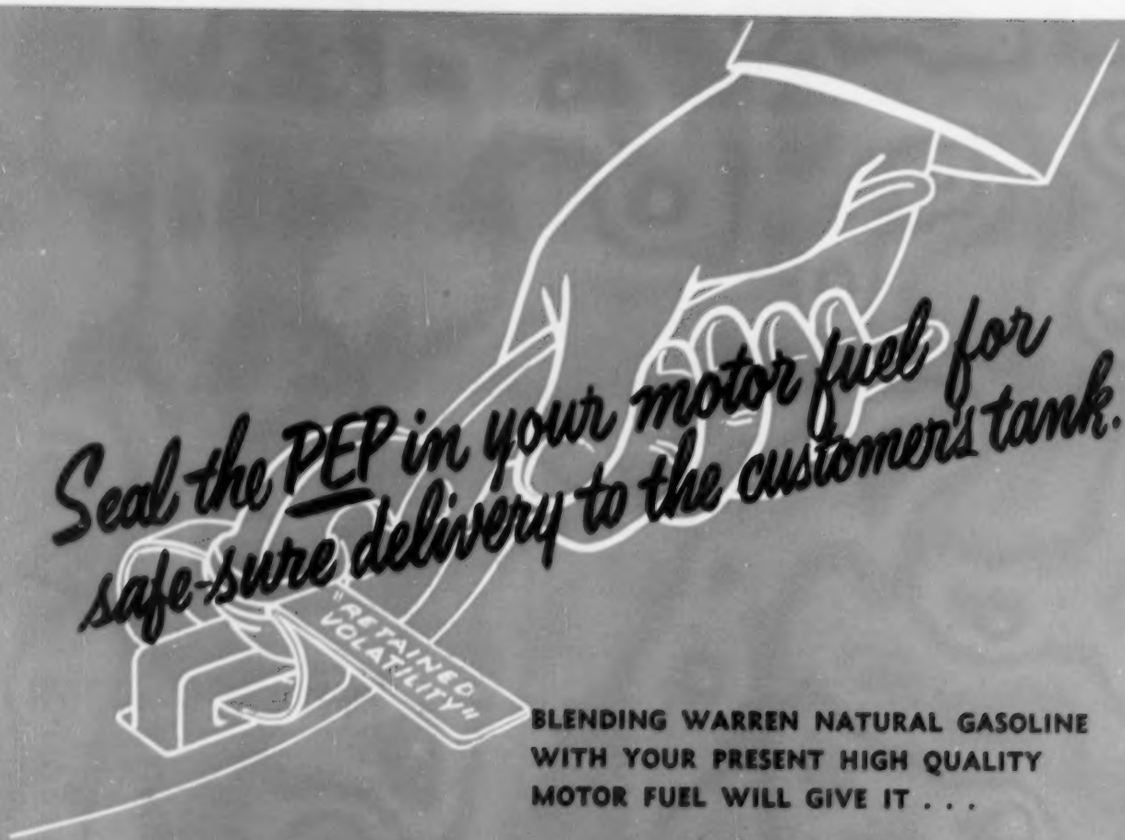
ONE DOLLAR PER COPY



Seal the PEP in your motor fuel for safe-sure delivery to the customer's tank...

BLENDING WARREN NATURAL GASOLINE WITH YOUR PRESENT HIGH QUALITY MOTOR FUEL WILL GIVE IT . . .

RETAINED VOLATILITY

You can depend on Warren's production, transportation, storage and SERVICE for the grade and quantity of NATURAL GASOLINE you need — when and where you want it.

WARREN
PETROLEUM CORPORATION

TULSA, OKLAHOMA • Cable Addresses: STAVOLENE, WARREN

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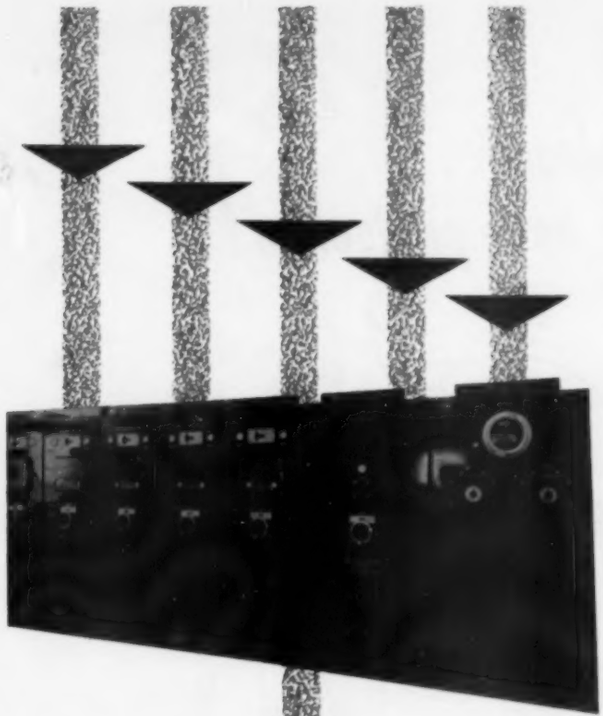


Proportioneers Gasoline Blender control panel with automatic batch cutoff panel at right, for continuously blending famous White Rose petroleum products at rates up to 2,880 barrels per hour.

Proportioneers Loss-In-Weight scale and control panels for adding TEL to finished gasoline in proportion to flow rate.

Stream Blending Produces Finished Gasolines at CANADIAN OIL REFINERIES, LTD.

The Proportioneers Stream Blending System continuously produces finished gasolines at Canadian Oil Refineries, Ltd., Sarnia, Ontario, automatically maintaining preset formulations at all flow rates of finished product. After the gasoline has been blended from straight run, polymer, catalytic, reformate, and butane . . . it is then leaded by Proportioneers Loss-In-Weight TEL Blender.

Proportioneers Blending Systems are serving refineries in 17 countries throughout the world. Our experience in the engineering, manufacture, and service of this advanced equipment is at your disposal. Write Proportioneers, Inc., 481 Harris Ave., Providence 1, Rhode Island.

WHITE ROSE

PROPORTIONEERS

DIVISION OF B-I-F INDUSTRIES, INC.

B-I-F METERS FEEDERS CONTROLS

SHOT in the right place... ...for best production!

"pin-point" accuracy, uniform hole pattern that gives equal coverage of all the productive zone, PLUS the most important factor of all... deepest penetration, gives you the results you want... MORE OIL!

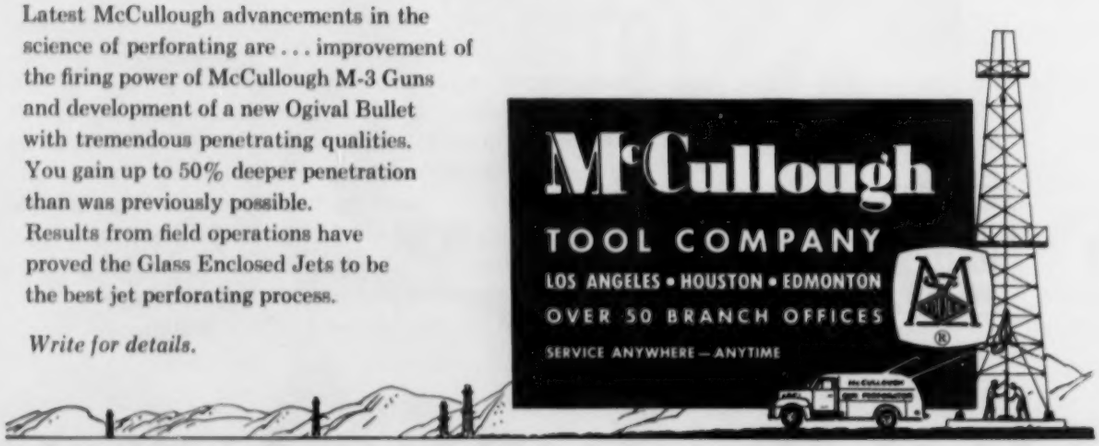
For Best Results, always specify—

McCULLOUGH PERFORATING SERVICE

— M-3 BULLET GUNS & GLASS JET PERFORATORS

Latest McCullough advancements in the science of perforating are... improvement of the firing power of McCullough M-3 Guns and development of a new Ogival Bullet with tremendous penetrating qualities. You gain up to 50% deeper penetration than was previously possible. Results from field operations have proved the Glass Enclosed Jets to be the best jet perforating process.

Write for details.



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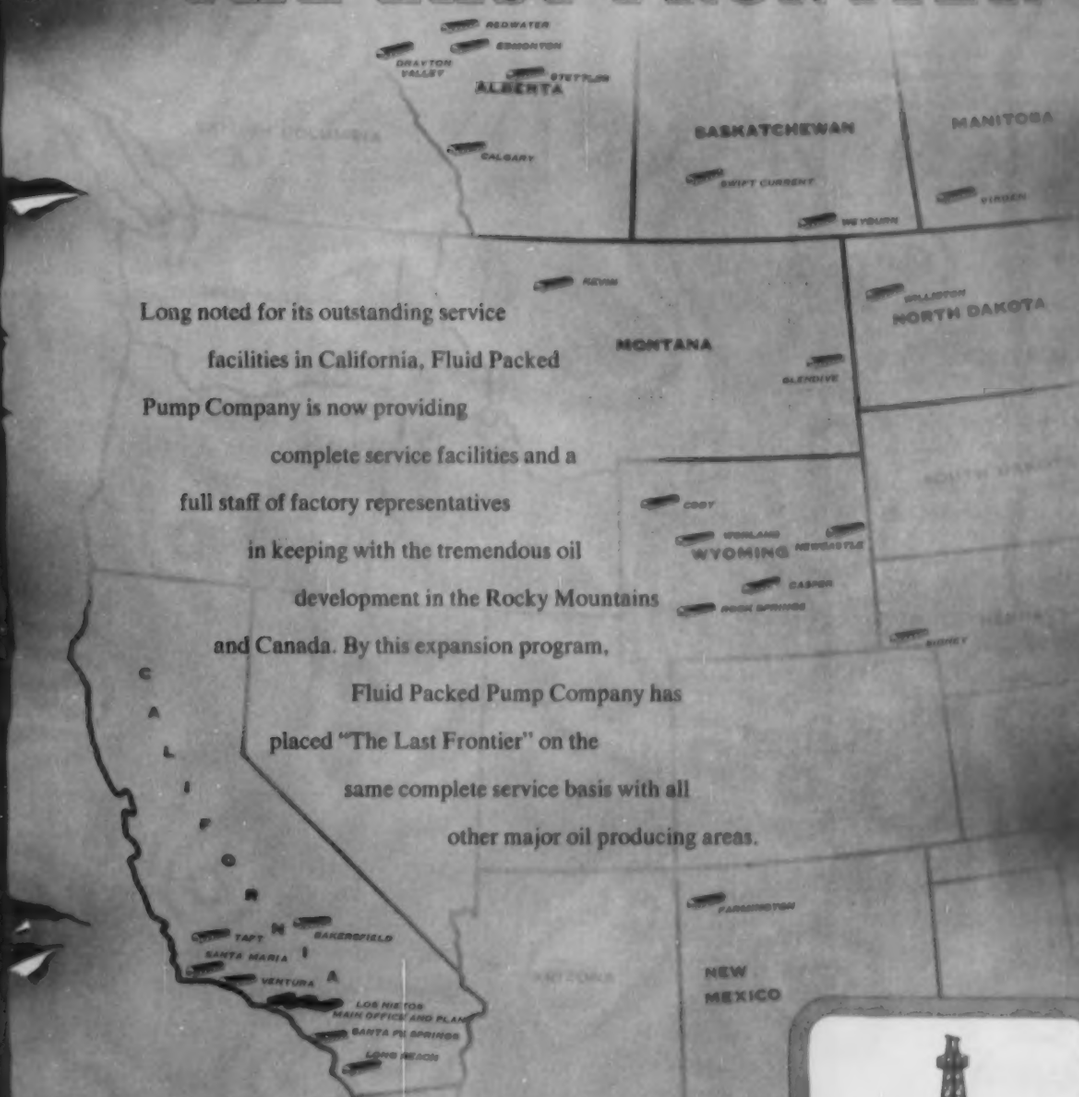
FLUID PACKED PUMP COMPANY

keeps pace with the development of

"THE LAST FRONTIER"



Long noted for its outstanding service facilities in California, Fluid Packed Pump Company is now providing complete service facilities and a full staff of factory representatives in keeping with the tremendous oil development in the Rocky Mountains and Canada. By this expansion program, Fluid Packed Pump Company has placed "The Last Frontier" on the same complete service basis with all other major oil producing areas.

FLUID PACKED PUMP CO.

MAIN OFFICE AND PLANT, LOS NIETOS, CALIFORNIA

Distributed by The National Supply Co., Pittsburgh, Pennsylvania

oilmaster PUMPS

FOREMOST IN THE INDUSTRY

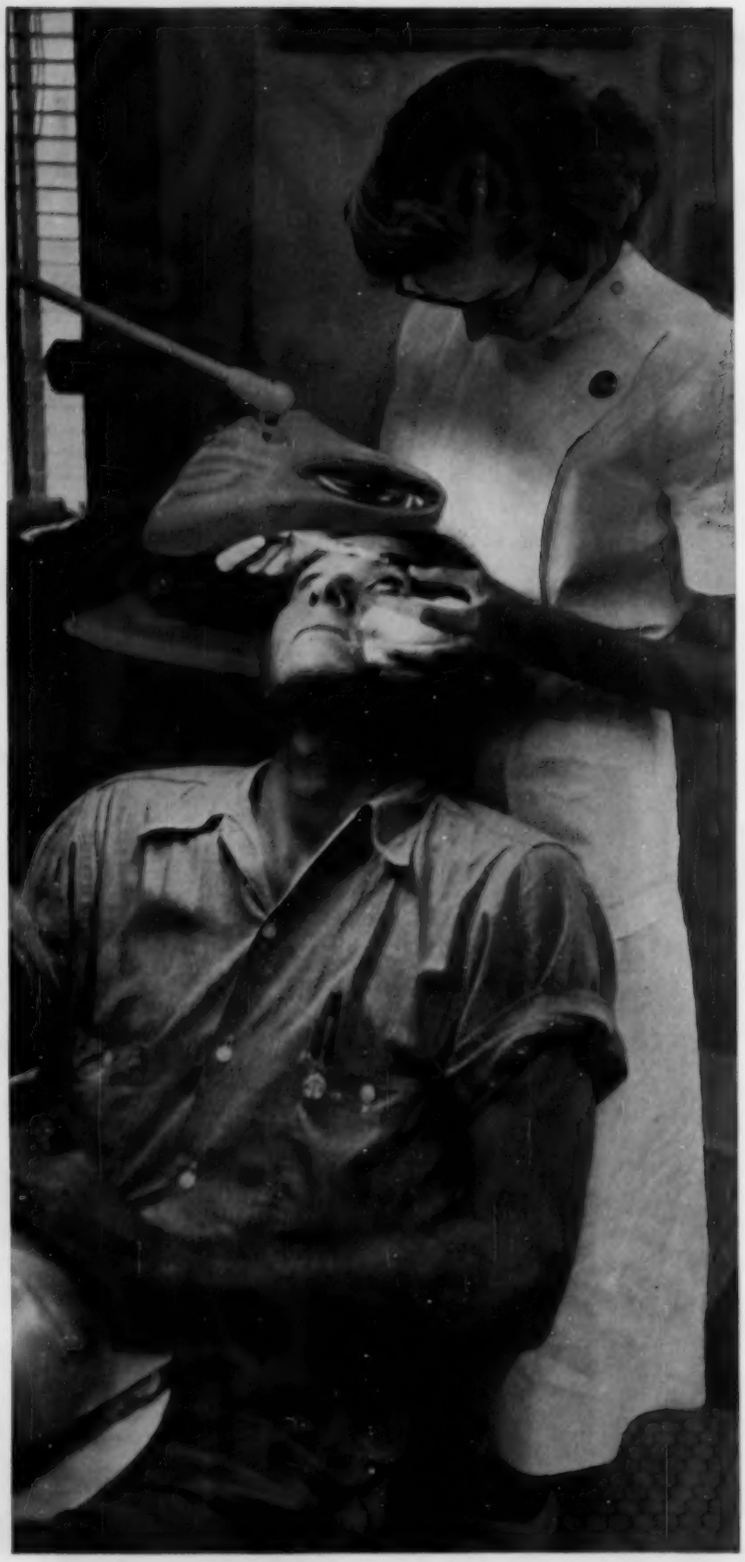
Oil woman...

She is one of the most important "oilmen" there is, although she may not work with a tank gauge or on a tank farm. Accidents can happen in any job. And when they do—the refinery nurse knows just *what* to do.

Whether it's a cinder in an eye . . . a cut finger . . . a broken leg . . . no matter *what* it is, she's there to help get emergency service under way. That's why it's important—and mighty comforting—to have her around.

The Texas Company

TEXACO



G-E Engineering Services, Equipment Can Give You... More Efficient ELECTRICAL SYSTEMS

Easy to expand General Electrical systems will help make modernization or expansion programs in petroleum refineries more economical. Here's why:

- **Flexible G-E system design simplifies the addition of new equipment.**
- **Versatile G-E equipment is easily incorporated into existing system.**
- **Experienced G-E engineers help plan, co-ordinate, and install system.**

MODERNIZING, EXPANDING, BUILDING? Whatever your plans, let experienced G-E engineers help plan a more efficient electrical system for you. They will work with you or your engineering contractors to give you correct answers to the following questions.

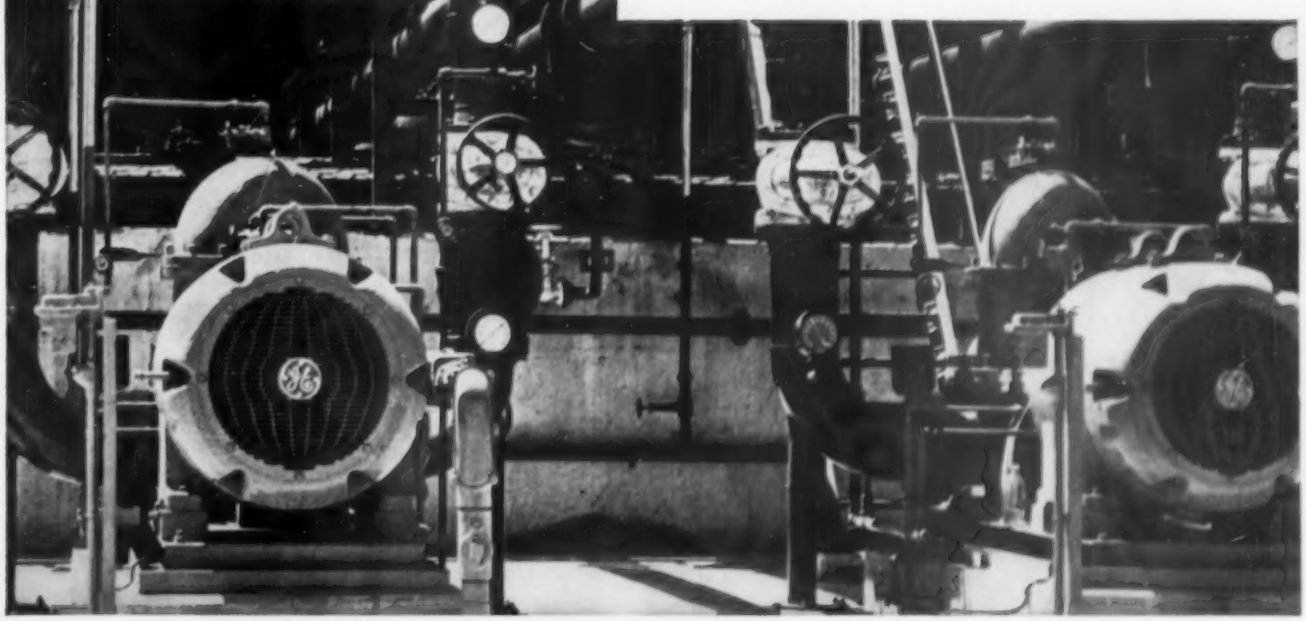
SHOULD YOU GENERATE OR PURCHASE POWER? G-E engineers will help make a "load" survey of your facilities, and recommend an economical solution to your particular power supply problem.

WHAT TYPE ELECTRICAL DISTRIBUTION SYSTEM SHOULD YOU INSTALL? The latest distribution system concepts will be reviewed with you by G-E engineers. They will help select and design a modern system to meet your individual requirements.

WHAT KIND OF DRIVE EQUIPMENT SHOULD YOU USE? Each application for drives in your processing lines will be individually examined by G-E engineers to assure that the proper drive is designated for the job.

WHERE CAN YOU UTILIZE AUTOMATIC CONTROLS? New developments in the field of automatic controls will be applied throughout your processing lines by G-E engineers. More information on outstanding new developments in the petroleum industry is available through the G-E representative nearest you. Consult him early in your planning. *International General Electric Co., 570 Lexington Ave., New York 22, N.Y., U.S.A.* 1A-55-7R

GENERAL ELECTRIC
—U. S. A.—



AUTOCAR — Star Performer

on the World's Toughest Hauling Jobs

HUSKY, RUGGED AUTOCAR TRUCKS are now distributed throughout the world by The White Motor Company.

They're proved performers—engineered and built for extra heavy hauling jobs . . . everywhere!

There is a wide choice of component units for the really BIG jobs . . . on and off-the-road . . . new work capacity and efficiency, no matter what or how big your hauling job is.

It's now part of the world's greatest Truck Power Team—an important part of the complete White line for really specialized and tough haulings jobs—around the world!

Check these exclusive Autocar Features!

- **AUTOCAR NUT AND BOLT CONSTRUCTION** contribute enormously to long life, low operating cost and outstanding performance.
- **BALANCED DRIVING ASSEMBLY** assures vibrationless and perfectly balanced crankshaft, driveshaft flywheel and clutch assembly.
- **RENEWABLE BUSHINGS AT CRITICAL WEAR POINTS** reduce maintenance cost and add life . . . protect parts wear.
- **NEW CAB COMFORT**—the Autocar "Driver" Cab of reinforced design with wide vision, 5-way adjustable seat, safety and driving ease.
- **DOUBLE REDUCTION REAR** adds power and strength for the really rugged jobs.
- **STRENGTH AND FLEXIBILITY IN AUTOCAR FRAMES** through use of husky heat-treated alloy steel rails.
- **SHEET METAL LASTS LONGER, TOO** because of heavier gage and duridizing treatment that resists action of the elements . . . for a longer lifetime of tough service.

Autocar

AUTOCAR EXPORT SALES • • • • EXPORT DIVISION
THE WHITE MOTOR CO. · CLEVELAND 1, OHIO, U.S.A. · Cables: WHITCO

Find out how Autocar can save you money . . . EARN MORE FOR YOU!

For full information about Autocar Trucks for your business, send the coupon to the White Export Division, Cleveland 1, Ohio, U. S. A.

Send me facts about Autocar motor trucks.

Name _____

Firm _____

Address _____

City _____ State _____

Positioning deposit sample in path of X-ray beam. Crystals of the deposit will diffract the beam, and a characteristic pattern is recorded on the chart at left.

Ethyl Research "fingerprints" engine deposits

At Ethyl laboratories our people have come up with several techniques that are helping us find out what to do about engine deposits.

One of these new techniques—called the "fingerprint" method—works something like this:

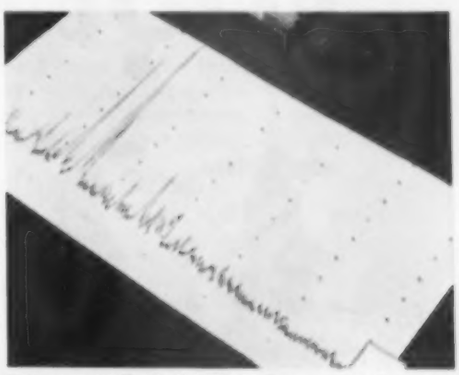
A special thermal plug is installed in the engine combustion chamber. Deposits are allowed to build up on the plug, which is held at a controlled temperature. After a certain time, the plug is removed, and the deposits are analyzed.

To identify the compounds present in the deposit, ordinary chemical analysis proved unsatisfactory, so Ethyl people turned to X-ray diffraction. But here again they met a problem. No master identification charts existed for these complex chemicals.

Ethyl synthesized and made X-ray diffraction "fingerprints" of many of the compounds they thought might be in the deposits. Now, with this unique master identification file, the majority of complex inorganic chemicals present in engine deposits have been identified.

With this basic research tool, Ethyl people are studying the mechanism of deposit formation and gaining new understanding which will lead to more effective scavenging of engine deposits in the future.

ETHYL ANTIKNOCK, LTD.
44 KING ST. WEST
TORONTO, CANADA



"Fingerprint" of the deposit is recorded on this chart—showing which compounds are present in the deposit sample.

Comparison of sample "fingerprint" with Ethyl's master file of synthesized compounds permits positive identification of chemical compounds present in the sample.

24 ACRES *Cover the World*

. . . with TOP QUALITY

DROP FORGED STEEL

VALVES, FITTINGS and FLANGES

by

Vogt

Air View of
Henry Vogt Machine Co.

This 24 acre Vogt plant supplies the most comprehensive line of top quality *drop forged* steel piping materials anywhere available to industry. That's why they're the choice of leading refineries, power plants, chemical plants, etc., the world around!

OUR COMPLETE LINE INCLUDES

Flanged, Screwed and Socket Weld End Globe, Gate and Check Valves • Ells, Tees and Crosses • Couplings • Bushings • Plugs • Unions • Flanges and Flange Unions • Welding Heads

HENRY VOGT MACHINE CO. LOUISVILLE 10, KY.

Branch Offices: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va.

INDIA — At Bombay's Santa Cruz Airport, a Caltex crew refuels one of TWA's sleek Constellations, a unit of the world's largest fleet of Connies and Super Constellations. Travelers depend on TWA for speed, comfort and safety... just as TWA calls on Caltex for fuels, lubricants and service that assure dependable engine performance and lower maintenance costs.

CALTEX serves the people of 67 lands

In 67 lands, across half the world, through such developments as these, Caltex supplies better fuels and lubricants for industry, for agriculture and for motoring millions. These require a continual investment of funds and skills, backed by a faith in a better future for free nations.

Petroleum Products

SERVING EUROPE • AFRICA • ASIA • AUSTRALIA • NEW ZEALAND

BAHRAIN — This modern service station is a busy "oasis" in the colorful Persian Gulf shaikhdom of Bahrain. Nearby, the Bapco refinery brings employment to many Bahrainis, assures a brighter economic future, produces petroleum products for markets halfway 'round the world.

ENGLAND — Big Ben is a familiar landmark in the world's largest city. Well known also is the lorry of the Regent Oil Company, Ltd. This Caltex affiliate in the United Kingdom supplies fine petroleum products so essential to progress.

..only part of the picture

OIL REFINERY ENGINEERS know that Newalls bring more than materials to the site, because they realise that even first class insulation materials cannot do justice to themselves unless they are efficiently applied. In fact, the task of planning that the right materials are used is a job studied carefully by Newalls before their recommendations are submitted. Through consultation with Newalls you can make very certain that method as well as materials is brought to bear on the problem. That's maybe why Newalls record of refinery insulation jobs makes such an impressive picture.

RECENT CONTRACTS **Among the large petroleum projects to which Newalls have supplied insulation materials recently are the Anglo Iranian Oil Company's new refineries at Aden and Kwinana and also the new Brazilian State Refinery at Cubatao, Brazil.**

Where there's a ***HEAT INSULATION*** *problem there's a job for* **Newalls**

NEWALLS INSULATION CO. LTD. *Head Office:* Washington, Co. Durham, England. *A member of the* TURNER & NEWALL ORGANISATION

Offices and Depots at LONDON, GLASGOW, MANCHESTER, NEWCASTLE UPON TYNE, BIRMINGHAM, BELFAST, BRISTOL & CARDIFF *Agents and Vendors in most markets abroad*

ANHYDROUS AMMONIA... 250 tons per day

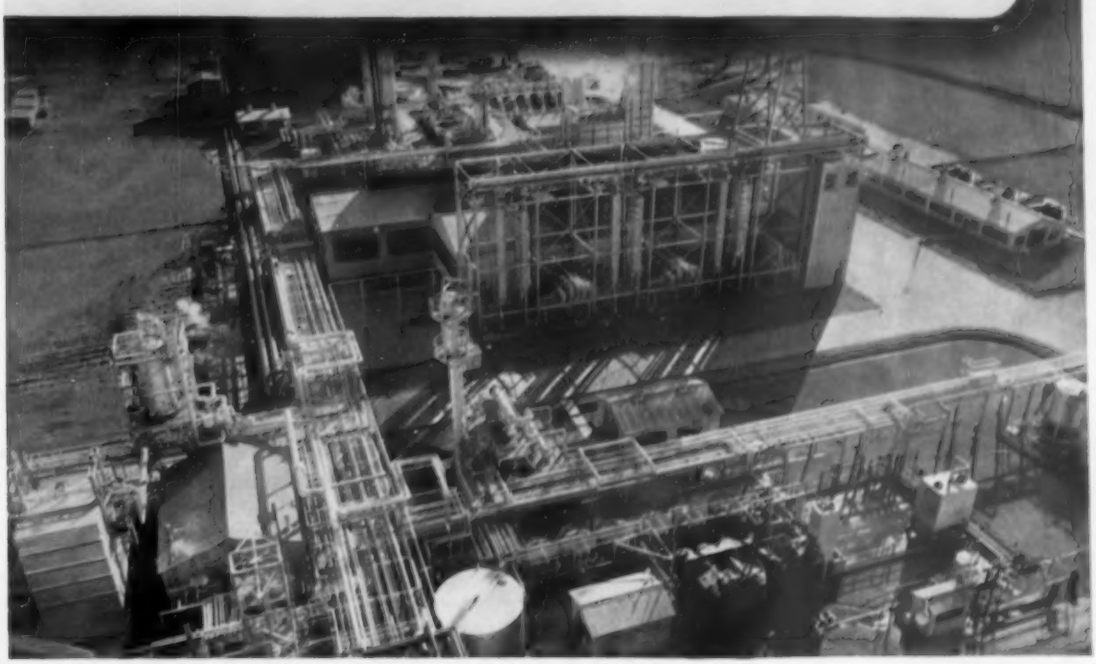
by the exclusive FW sequence

Another Ammonia Synthesis Plant by Foster Wheeler now on stream at Grace Chemical Company

Designed and built by Foster Wheeler, this modern Grace Chemical Co. plant at Memphis, Tenn. has a capacity of 250 tons of anhydrous ammonia per day.

It is another outstanding example of the proved economy and dependability of the FW Sequence — Texaco partial oxidation, FW liquid nitrogen wash and Casale ammonia synthesis. Write for the March-April issue of Heat Engineering, containing the complete story. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

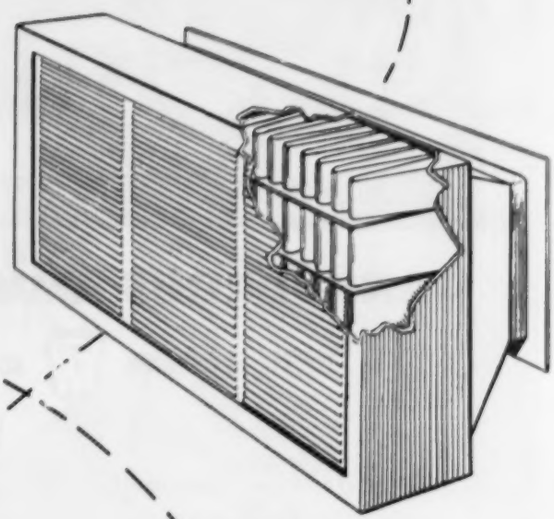
FOSTER WHEELER

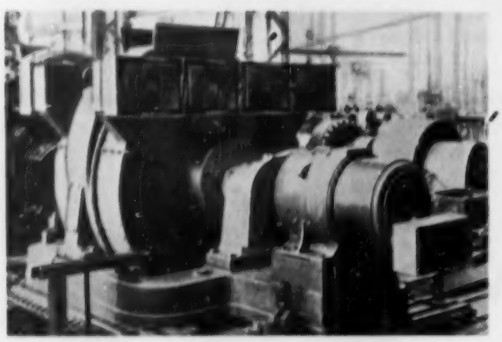


VOKES FILTERS

play a vital part in keeping the oil flowing...

In the blinding desert dust storms which sweep the area of the Iraq pipelines, VOKES filters have twice been chosen for the important task of protecting pumping stations and ancillary equipment . . . proof indeed of the important part which VOKES filtration is playing throughout the world in safeguarding plant and machinery from wear, breakdown and unnecessary depreciation. Below are shown three typical aspects of VOKES protection . . . protection which cannot be jeopardized by the non-availability of element replacements because VOKES FILTERS ARE CLEANABLE.





MICRO-VEE PANEL FILTERS FOR ELECTRIC MOTORS

Electric motors breathe too! . . . and these VOKES filters have proved conspicuously successful in preventing the grave damage hitherto sustained during operations in impure air conditions.

VOKES FILTERS FOR ANCILLARY EQUIPMENT

Compressors . . . portable generators . . . welding sets . . . power packs . . . all need protection against the ingress of abrasive dust, whether by air-intake, lubricating oil or fuel.

VOKES FILTERS FOR STATIONARY DIESEL ENGINE

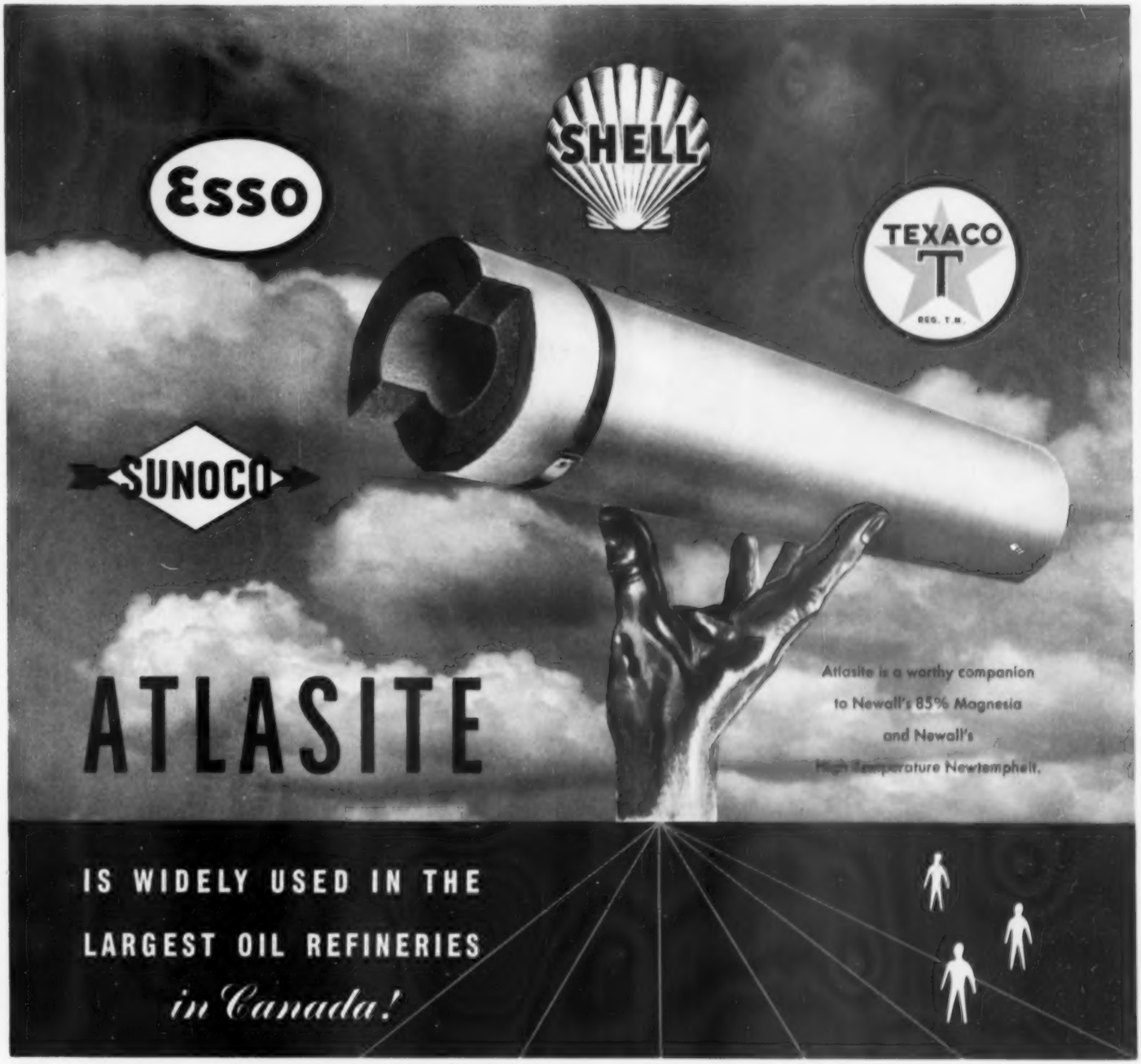
Under abnormal conditions like these, engines have to be doubly protected and these large diesel engines are therefore fitted with Microvee dry fabric filters for cleaning the intake air. Vokes Filters are also specified for atmospheric air filtration in the ventilating systems of many of the desert buildings.

VOKES LIMITED

VOKES LIMITED. *Head Office:* GUILDFORD, SURREY, ENGLAND

London Office: 123, Victoria Street, Westminster, S.W.1 • Vokes (Canada) Ltd., Toronto • Represented Throughout the World • Vokes Australia Pty. Ltd., Sydney

V116A

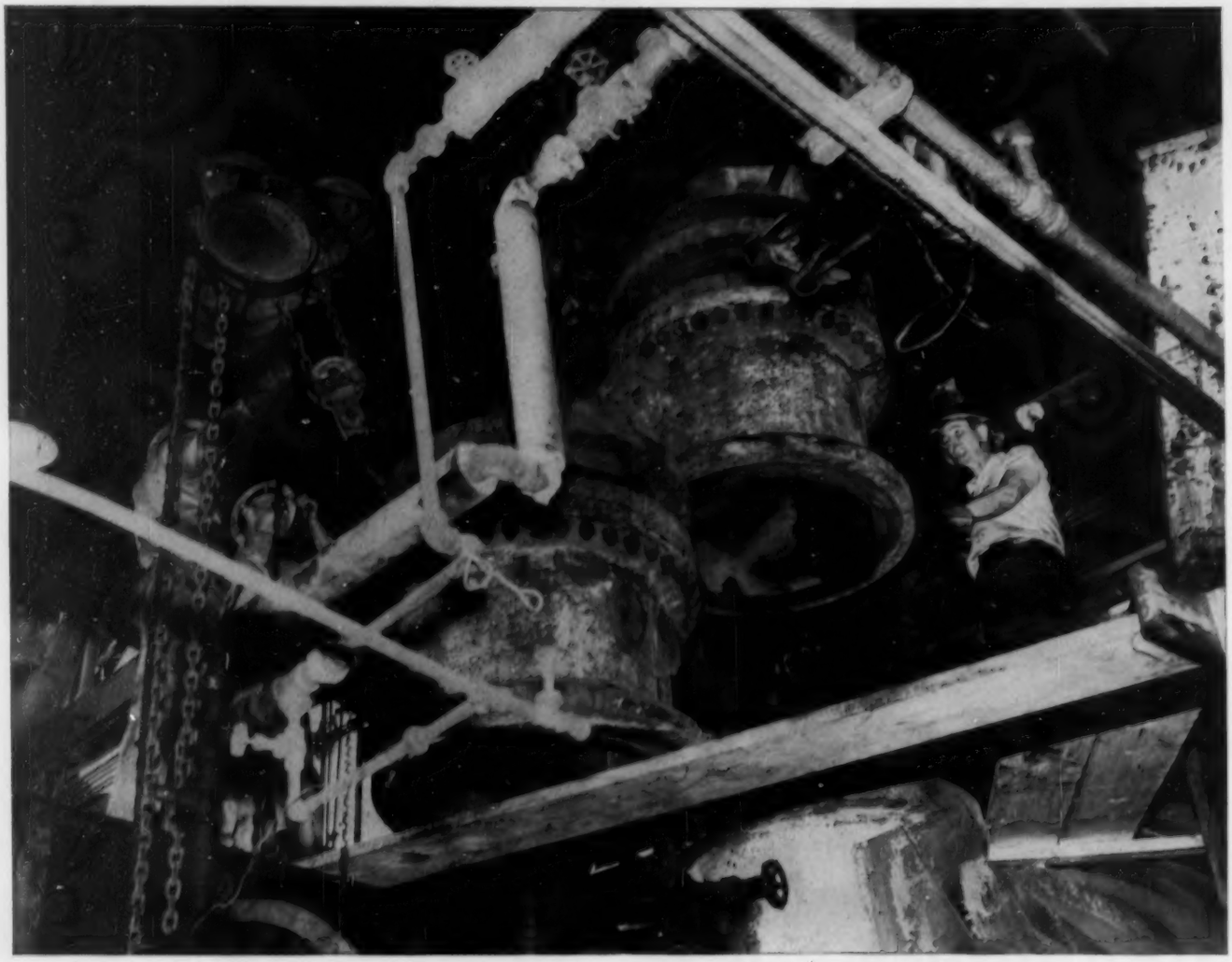


ATLASITE is a rugged insulation with a temperature limit that is conservatively placed at 850°F. Its structure has been developed to permit easy removal and re-application without damage. Basically it is Amosite fibre which is peculiarly well suited to give maximum insulation. Atlasite is in use on the refineries of the above companies and is also widely used throughout Canadian industrial plants. It comes in pipe, block and sheet forms and is available in all standard sizes and thickness and can be manufactured in any special sizes required.

Atlas Asbestos is the only plant in Canada manufacturing a complete line of pipe and block insulation materials ranging from low to high temperatures.

55-1

ATLAS ASBESTOS
COMPANY LIMITED
A member of the Turner & Newall Organization
MONTREAL TORONTO WINNIPEG VANCOUVER



TURNAROUNDS BY PROCON

During the first quarter of this year, seven petroleum refineries have entrusted Procon with their turnaround projects, knowing that their on-stream operations would be resumed after just a short period of down-time. With the rapid completion of this important preventive maintenance work, these refiners were assured of continuous trouble-free operations in the production of high-quality petroleum products.

The outstanding record achieved on these projects is typical of the many services available to refiners when Procon is on the job. It will be to your advantage to plan your next turnaround operation with Procon.

PROCON *Incorporated*

1111 MT. PROSPECT ROAD, DES PLAINES, ILLINOIS

PROCON (CANADA) LIMITED—40 ADVANCE ROAD, TORONTO
PROCON (GREAT BRITAIN) LIMITED—112 STRAND, LONDON

WORLD-WIDE CONSTRUCTION FOR THE PETROLEUM, PETROCHEMICAL, AND CHEMICAL INDUSTRIES

The many strategically-located Continental Stores offer quality equipment and unsurpassed out-of-stock service.

EVERYTHING...YES

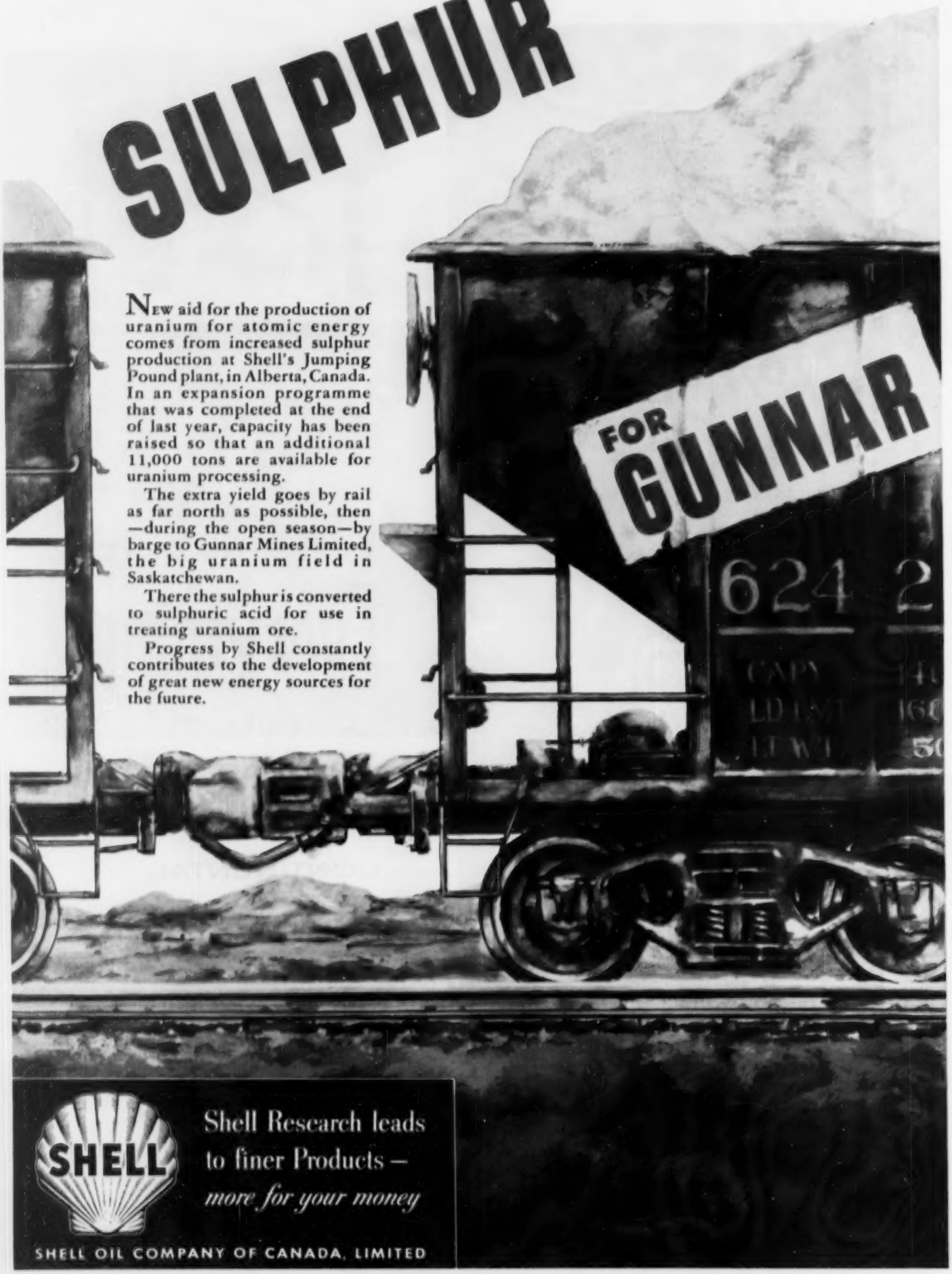
Everything

TO DRILL OIL
AND GAS WELLS
IS AVAILABLE AT
CONTINENTAL

CONTINENTAL
SERVING THE OIL AND GAS INDUSTRIES

THE CONTINENTAL SUPPLY COMPANY
General Offices: DALLAS, TEXAS
CANADA: CALGARY, ALBERTA
Representatives in All Principal Oil Fields of the World

SULPHUR



New aid for the production of uranium for atomic energy comes from increased sulphur production at Shell's Jumping Pound plant, in Alberta, Canada. In an expansion programme that was completed at the end of last year, capacity has been raised so that an additional 11,000 tons are available for uranium processing.

The extra yield goes by rail as far north as possible, then —during the open season—by barge to Gunnar Mines Limited, the big uranium field in Saskatchewan.

There the sulphur is converted to sulphuric acid for use in treating uranium ore.

Progress by Shell constantly contributes to the development of great new energy sources for the future.

SHELL

Shell Research leads to finer Products — *more for your money*

SHELL OIL COMPANY OF CANADA, LIMITED

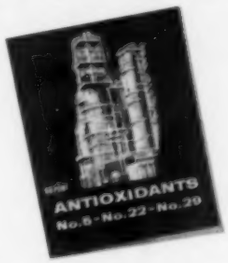
DU PONT

PETROLEUM CHEMICALS DIVISION NEWS

DU PONT

May ★ One of a Series of Interest to the Petroleum Industry ★ 1955

NEW ANTIOXIDANT BOOK NOW AVAILABLE



The complete line of Du Pont Antioxidants – Nos. 5, 22 and 29 – is fully discussed in a new 32-page book.

In addition to the regular application of these antioxidants in motor and aviation fuels, the new book covers the antioxidant sweetening process. It also discusses fully the properties and methods of addition of Du Pont Antioxidants. And there are informative chapters on the general history and function of antioxidants.

The book is profusely illustrated with drawings, colored charts and detailed diagrams. If you would like a copy, just write or mention it to any of our Petroleum Chemicals Division representatives or regional offices.

Refiners can now reduce gasoline treating costs

You can now save about 6% on the cost of Du Pont Gasoline Antioxidant No. 22 . . . by purchasing in tank car lots. In these days of shrinking profit margins, this cost reduction can be an important advantage to you.

Special Cars

To make it convenient for you to take advantage of this saving, Du Pont has available special tank cars with a capacity of 4,000 gallons, or approximately 31,000 pounds of antioxidant. They are equipped with steam coils to facilitate unloading.

Additional Help

Also, the Operations Group of the Du Pont Petroleum Chemicals Division will be glad to help you work out any individual unloading or storage problems which tank car shipments might entail. And any of our representatives or regional offices will be glad to give you further information on these tank car shipments.

A DU PONT SALES SERVICE

To help you take advantage of new lube oil promotion opportunities

Never before have you been able to offer a motor oil with an effective low-duty detergent. But there are now two new polymeric additives that make this possible – Du Pont Lube Oil Additives 564 and 565. And with such an outstanding advantage, they also offer you unique promotion opportunities.

To help you make the most of these opportunities, the Du Pont Petroleum Chemicals Division has prepared a special advertising and promotion kit.

YOU CAN BUILD a complete lube oil promotion plan around the wide variety of suggested copy ideas and other aids contained in this kit.

This kit is stuffed with useful aids and suggestions for promoting your brand of lube oils containing one of these new Du Pont additives. It includes *suggested* copy and layout for newspaper ads, descriptive folders, and a 24-sheet highway poster and window sticker.

Provocative Ads

One of the newspaper ads is designed to focus the attention of the average motorist on the fact that he actually gives his engine harder wear than the typical long distance trucker. The copy then points out that your brand of motor oil contains a special additive with a detergent action to retard the formation of engine sludge and varnish caused by average stop-and-start driving conditions.

Another suggested ad is built around the common problem of water dilution in the crankcase. It clearly explains how low-duty driving in traffic accentuates this problem . . . and how the polymeric Du Pont additives prevent harmful sludge from forming—even in the presence of water.

To meet your individual promotion requirements, the ads can be readily reduced or increased in size. And the suggested 24-sheet highway poster

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

PETROLEUM CHEMICALS DIVISION
NEWS

CONTINUED **Lube Oil Promotion**

can be adapted in size to become a window sticker or station banner.

The copy for these ads and booklets, however, should be rewritten and individually slanted to incorporate the regular competitive features of your own brand of motor oil.

Other Helps

The kit also includes a 12-page technical book and background articles on the development and special properties of these new polymeric lube oil additives. These can be especially helpful to you in tailoring your own promotion material for introducing a new product containing one of these additives.

In addition, there are suggested sales talks to acquaint and excite your dealers with the outstanding advantages of your new product.

SUGGESTIONS for folders, envelope stuffers, a 24-sheet highway poster, window sticker and banner are included on this typical page from the kit.

If you are now using, or are planning on using one of these new Du Pont additives in your lube oils, you will certainly want to take advantage of the special helps contained in this promotion kit. For full details, get in touch with any Du Pont Petroleum Chemicals Division representative or regional office.

DETROIT DISTRICT MANAGER

PAUL H. RICHARD has been named manager of the newly-formed Detroit District of the Du Pont Petroleum Chemicals Division. This district comprises the major portion of the state of Michigan.

An automotive specialist, Mr. Richard will work closely with the automotive industry on combustion and lubrication problems in addition to oil company sales-service contacts.

Joining the Du Pont Company in 1949, he was first assigned to engine research work on fuel scavenging agents. From 1943 to 1947 he was with the National Advisory Committee for Aeronautics, where he worked on fuel evaluation, cooling, compound power plants and turbo-jet fuel systems. Later, with the Lima-Hamilton Corporation, he worked on locomotive diesel engines and free-piston gas turbine power plants.

Mr. Richard was graduated from Pennsylvania State College with a B.S. degree in mechanical engineering. He is a member of the Society of Automotive Engineers.

New slide presentation to help your dealers sell themselves

An animated talking cash register acts as master of ceremonies for this unusual slide presentation. As it speaks, color slides are projected onto a screen beside it.

Prepared by Du Pont, this 20-minute educational program is designed for use by oil industry marketing groups in their regularly scheduled meetings with dealers and salesmen. The title is "SELL YOURSELF."

The sales value of improving human relations with customers is the central theme of the presentation. The slides and accompanying script encourage service station attendants to capitalize on the selling power of personal neatness, pleasant, friendly conversation and common courtesy. The fact that women motorists are important, valued customers is also pointed out.

The whole program is wrapped around an interesting plot. The central characters are Joe Wright, an on-the-ball service station operator, and Joe Wrong, a sloppy, unfriendly type of operator. The presentation demonstrates why Joe Wrong's approach is unsuccessful—while on the other hand, Joe Wright's personal selling keeps his cash register ringing.

If you would like to supplement your own dealer training program with one of these "Sell Yourself" presentations, any of our regional offices will be glad to give you full information on obtaining it.

DU PONT
Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • *Wilmington 98, Delaware*

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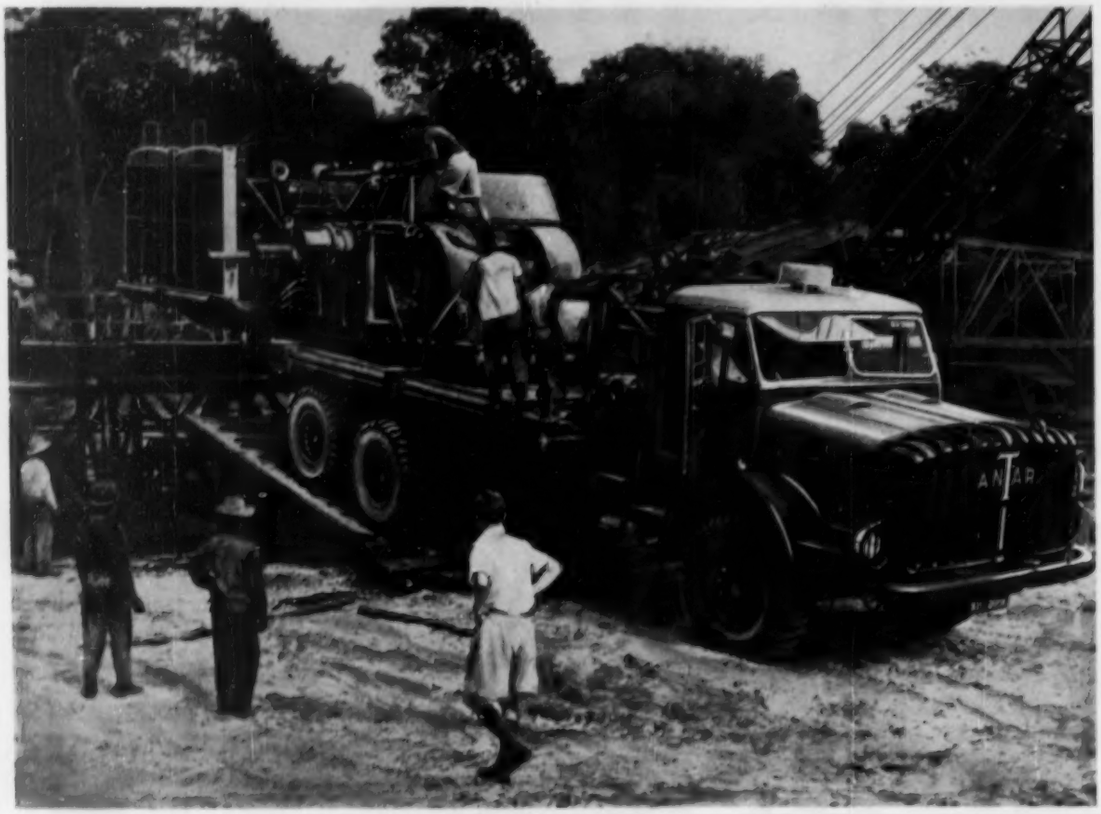

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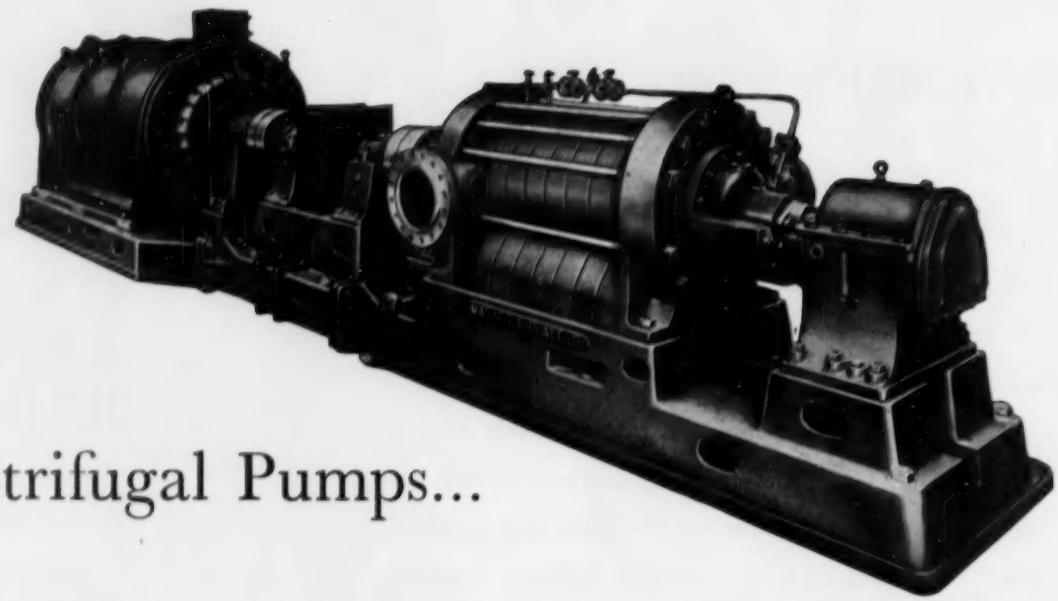

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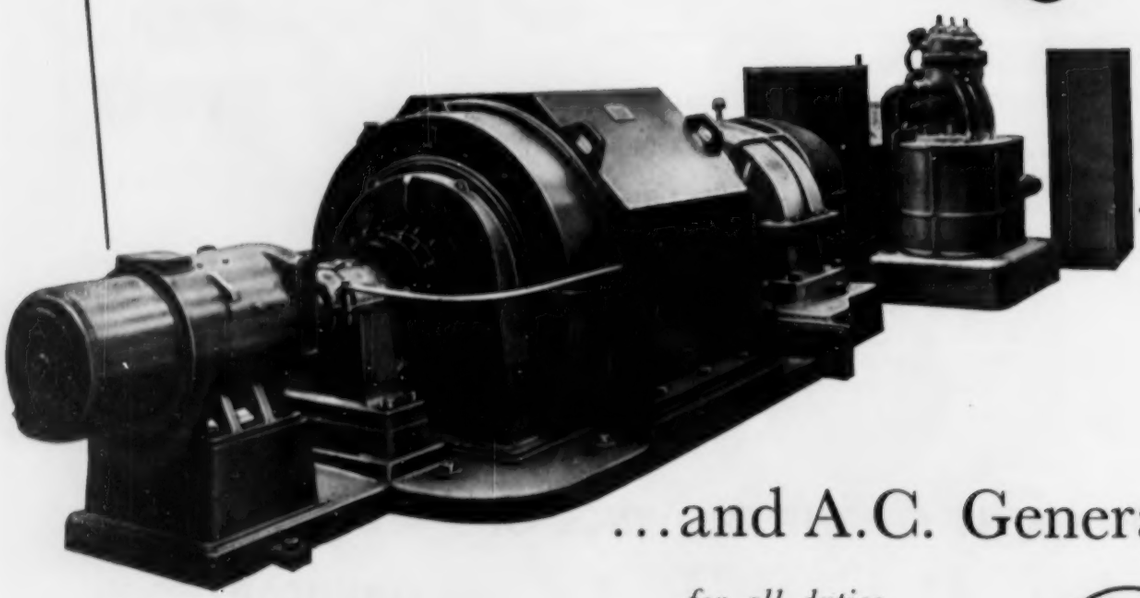

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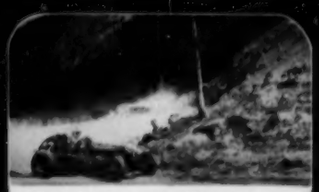

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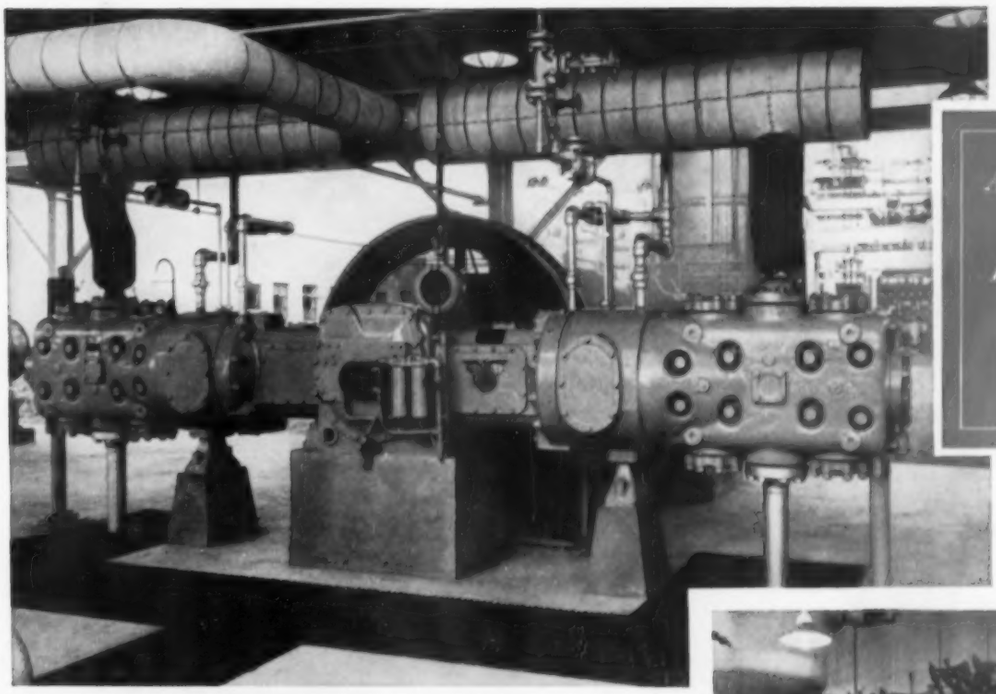

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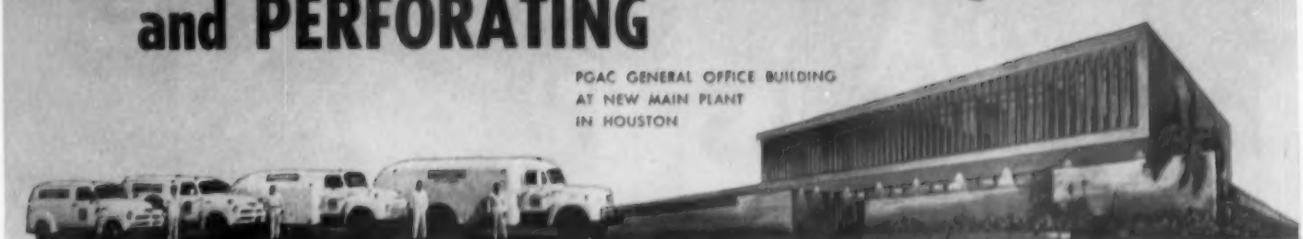

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16	140	216	317	430	560												
17	148	230	337	465	596												
18	157	244	357	484	630	800											
19	166	257	377	510	665	845	1030										
20	175	271	397	538	700	889	1085	1320	1580	1850	2140	2460	2800	3170			
21	184	288	417	564	735	934	1140	1390	1660	1940	2240	2580	2940	3330			
22	193	306	437	591	770	978	1195	1455	1740	2030	2350	2700	3080	3490			
23	201	313	457	617	806	1030	1250	1520	1820	2130	2460	2830	3220	3640			
24	210	327	478	644	840	1066	1306	1590	1900	2220	2560	2950	3360	3800			
25	218	340	498	672	875	1110	1360	1655	1980	2310	2670	3075	3500	3960	4430	4920	5430
26		354	518	697	910	1150	1420	1730	2060	2410	2770	3200	3640	4110	4600	5130	5670
27		367	538	724	945	1195	1470	1785	2140	2500	2880	3320	3780	4260	4780	5320	5890
28		381	558	751	980	1240	1525	1850	2220	2590	2990	3444	3920	4430	4955	5520	6110
29		395	578	778	1015	1285	1580	1920	2300	2680	3090	3570	4060	4580	5140	5710	6330
30		409	598	804	1050	1330	1635	1985	2375	2780	3200	3690	4200	4750	5300	5910	6540
31			618	831	1085	1375	1690	2050	2460	2870	3310	3820	4340	4900	5480	6110	6780
32			638	858	1120	1415	1745	2120	2530	2980	3410	3940	4480	5050	5660	6310	6980
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38				1018	1330	1680	2070	2510	3010	3510	4050	4670	5340	6000	6720	7490	8260
39				1045	1365	1725	2125	2580	3090	3600	4150	4800	5470	6160	6900	7690	8500
40				1072	1400	1770	2180	2645	3170	3700	4260	4930	5610	6320	7170	7890	8730
41						1815	2240	2710	3260	3790	4360	5050	5750	6480	7230	8090	8950
42						1860	2290	2780	3320	3890	4470	5160	5890	6640	7430	8280	9160
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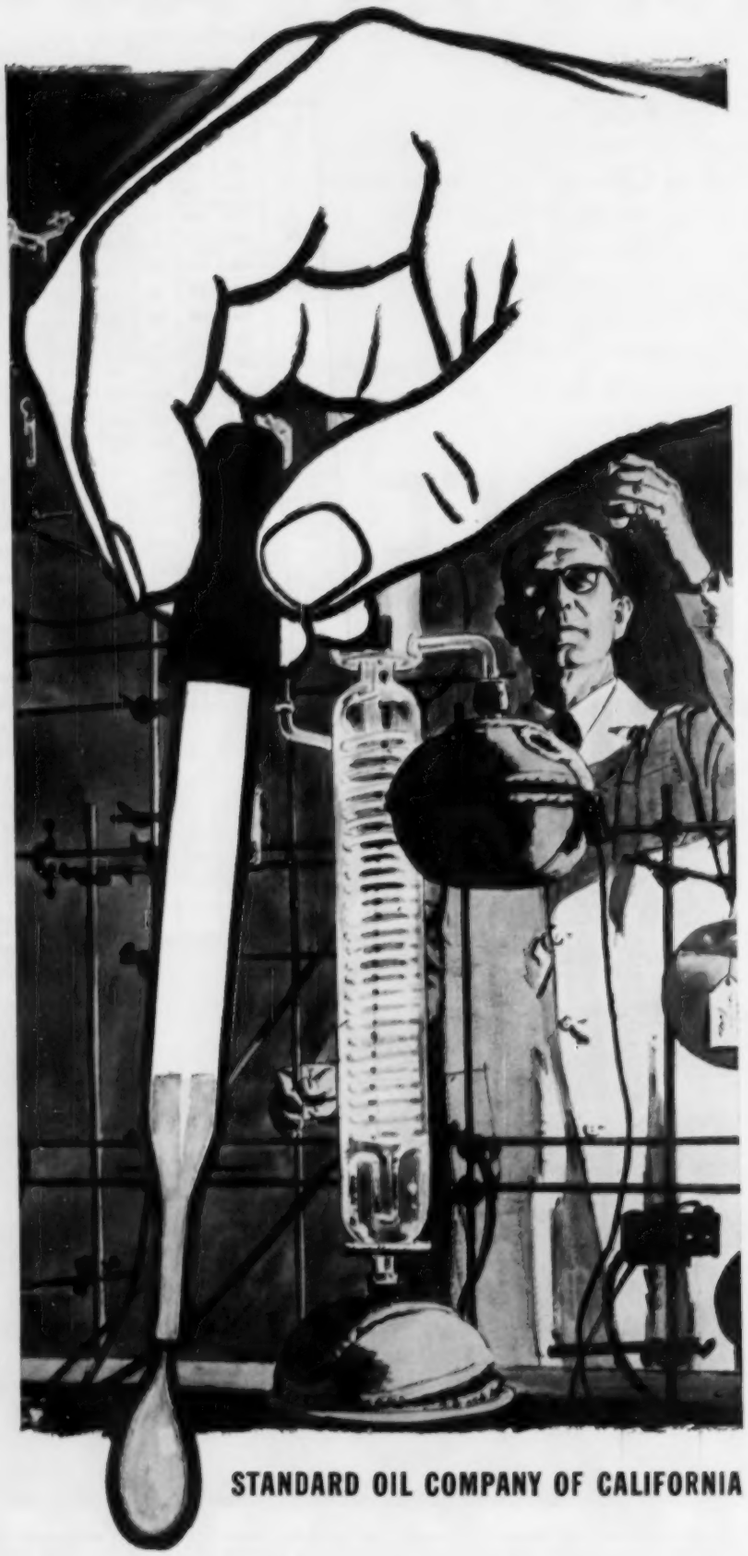

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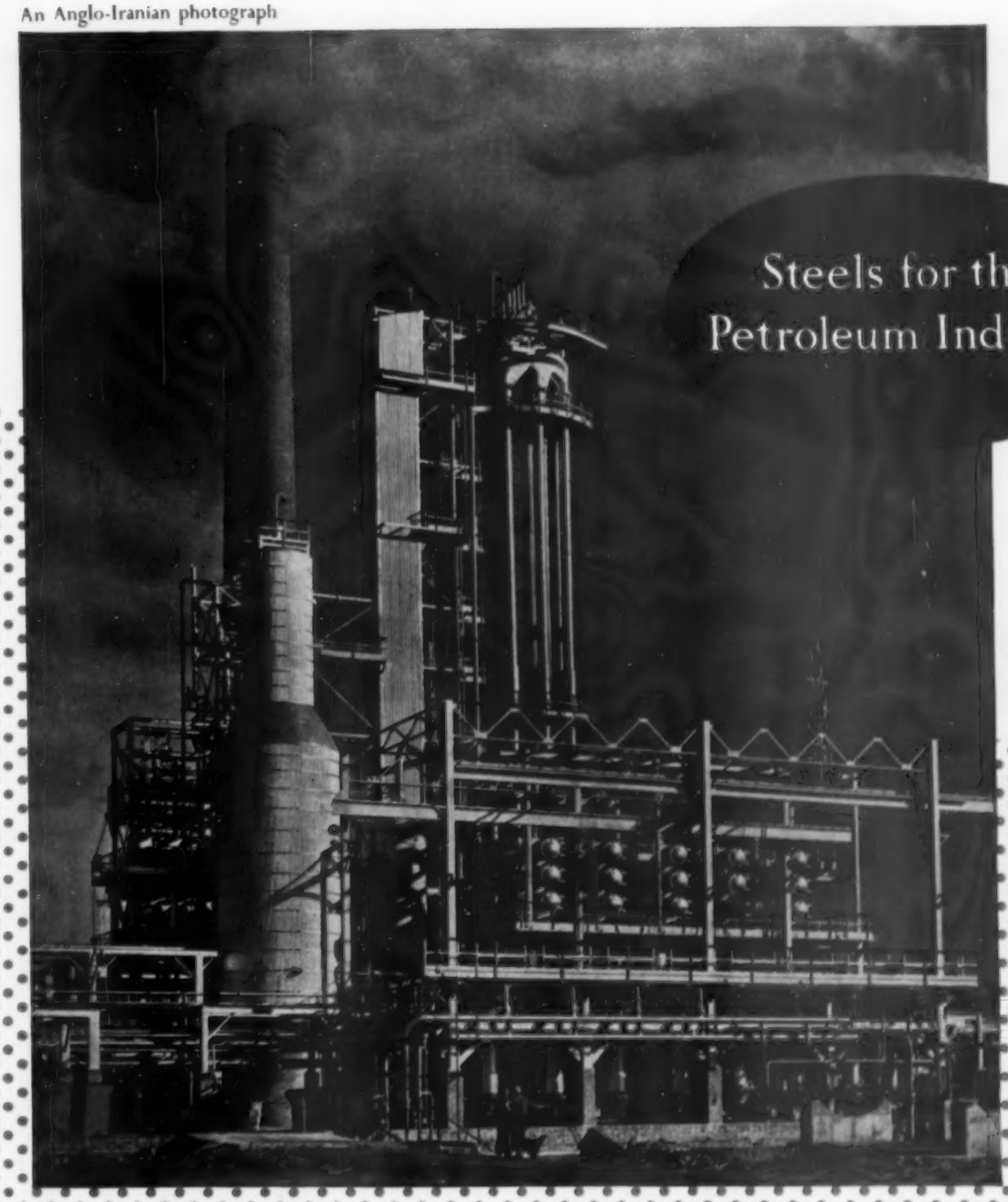

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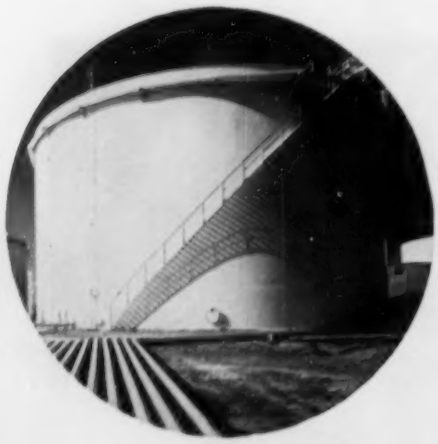

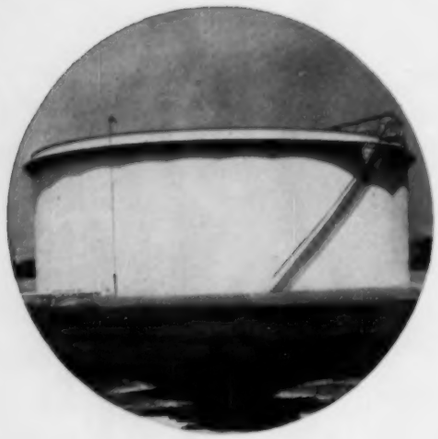

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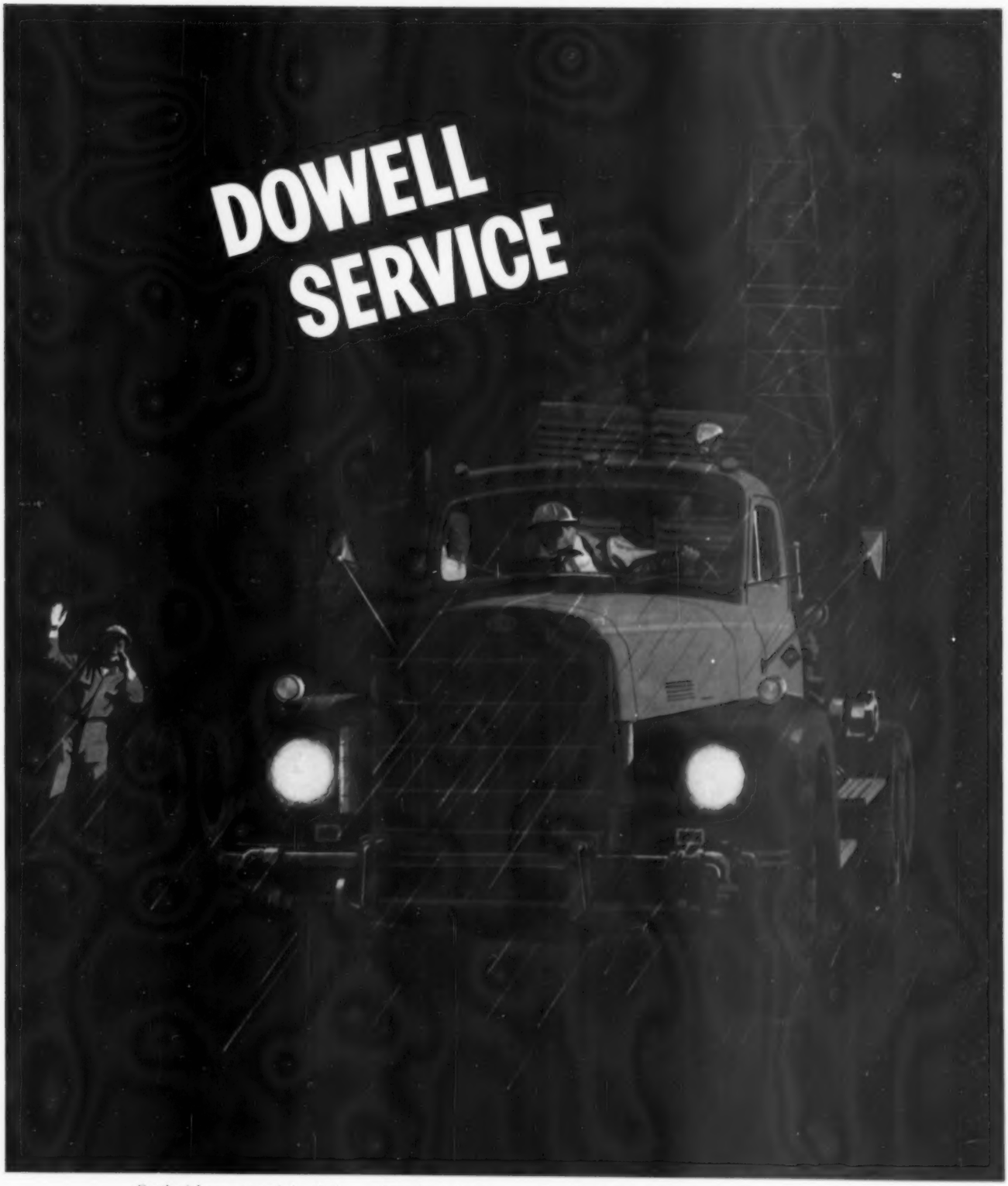

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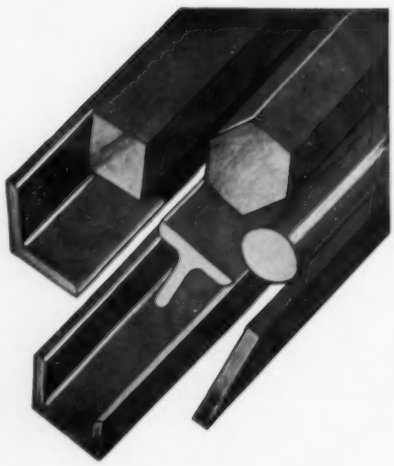

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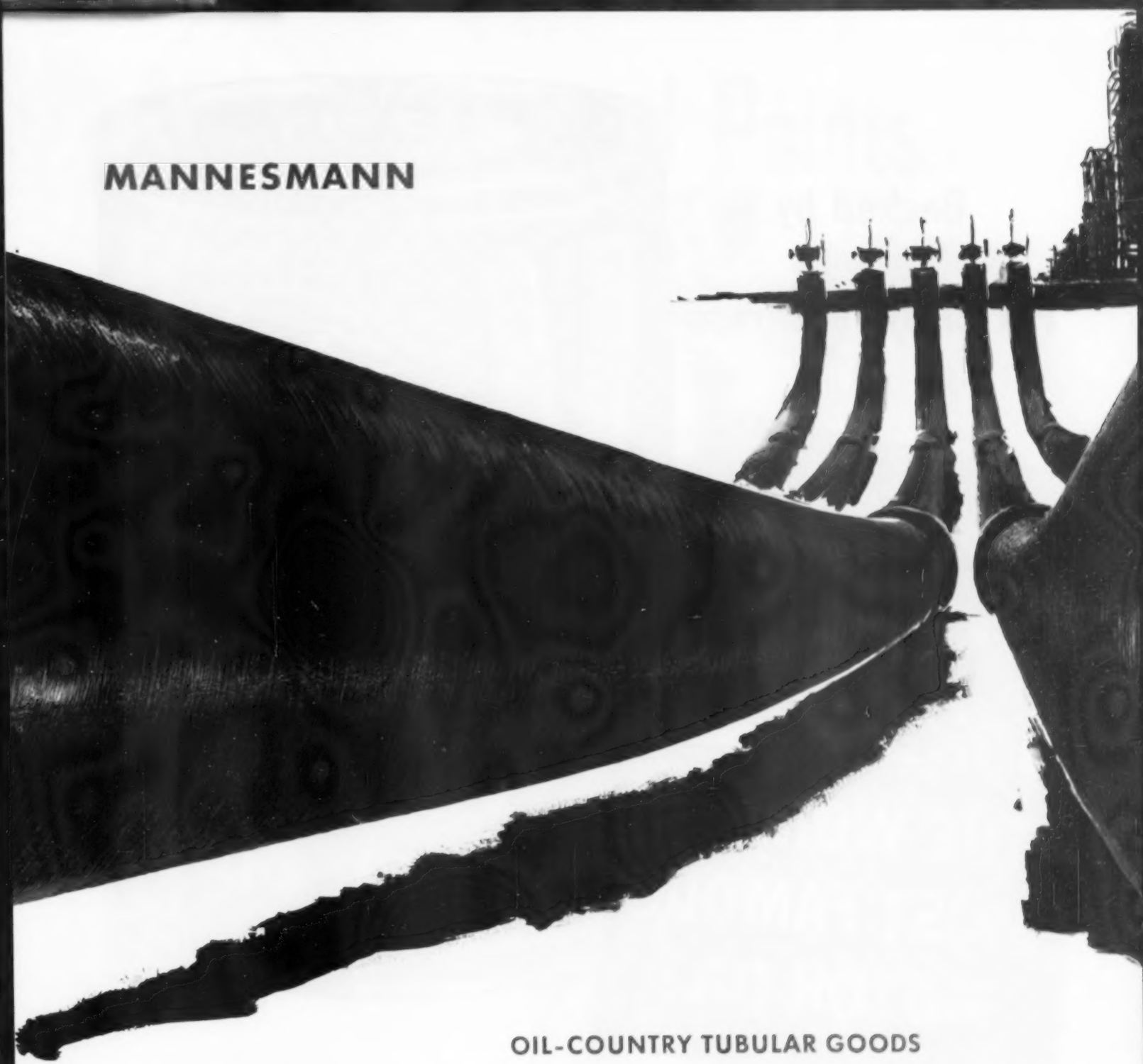

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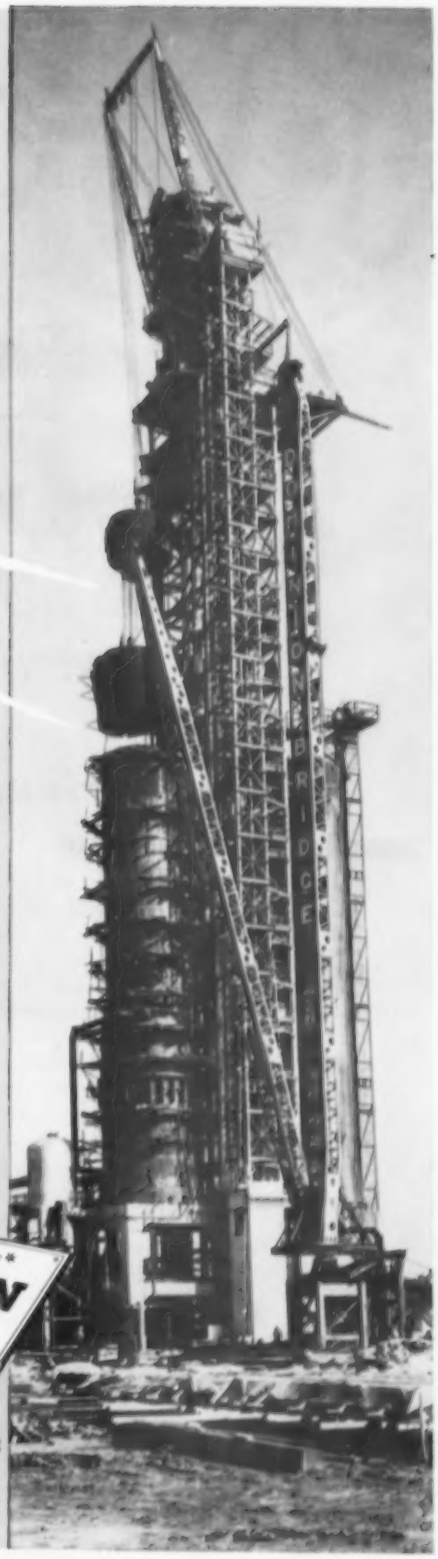

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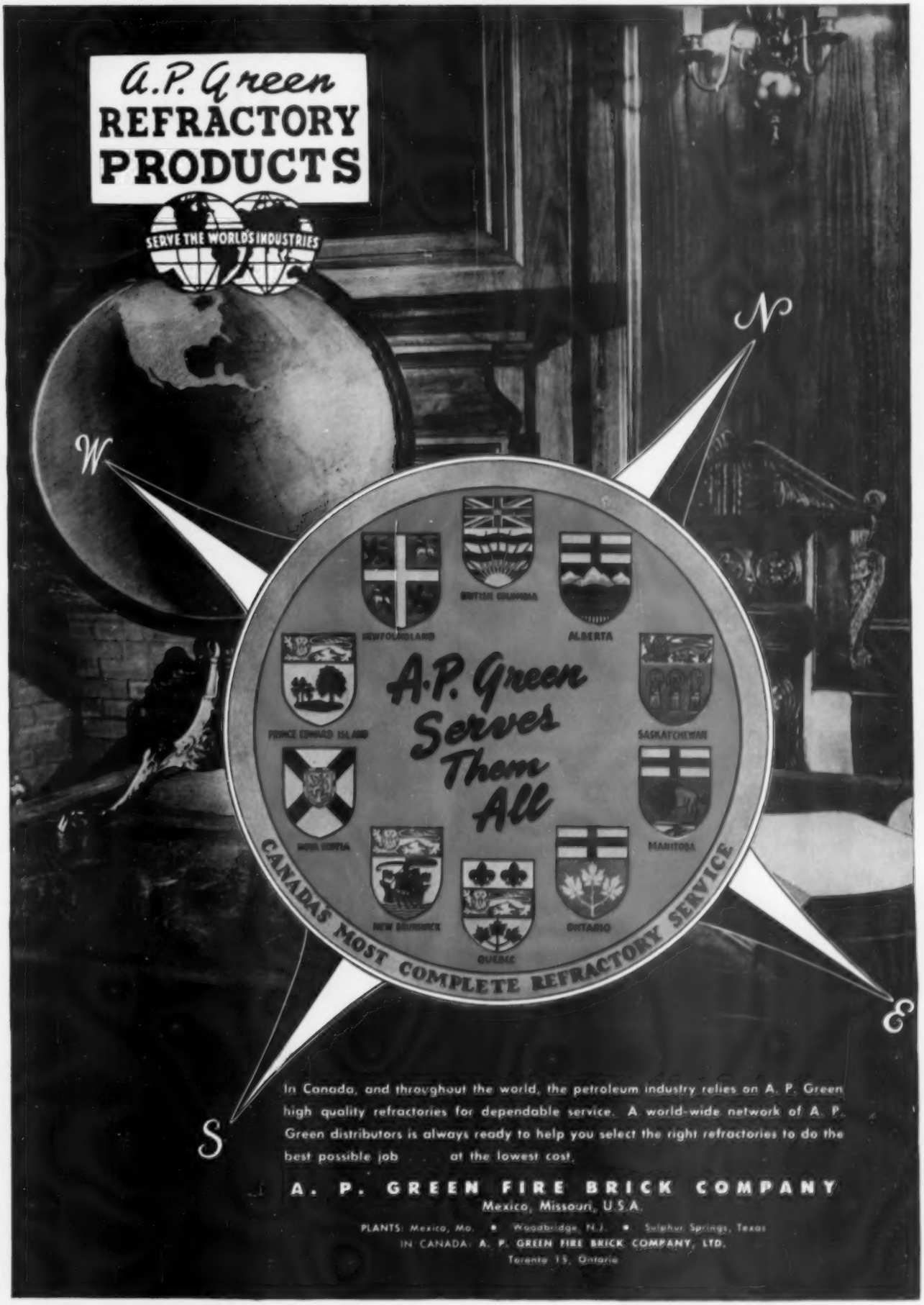
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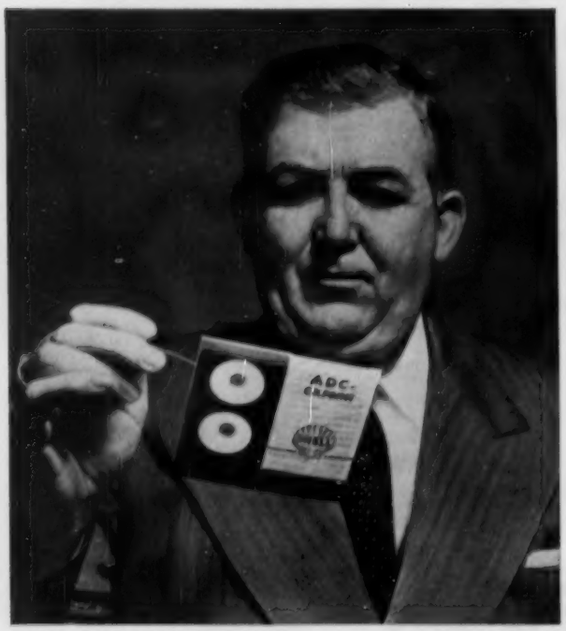

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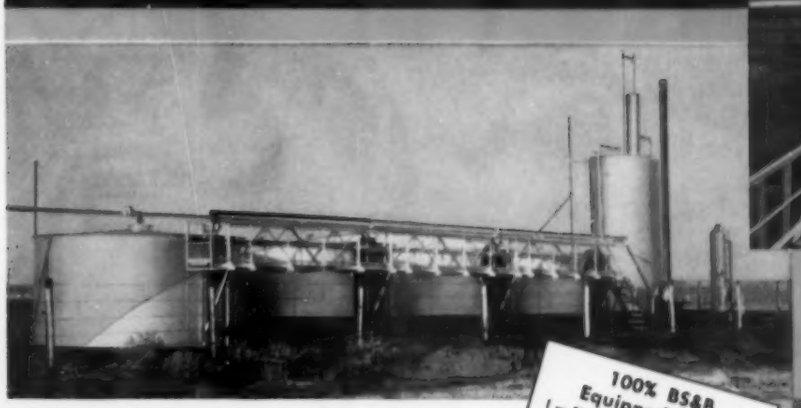

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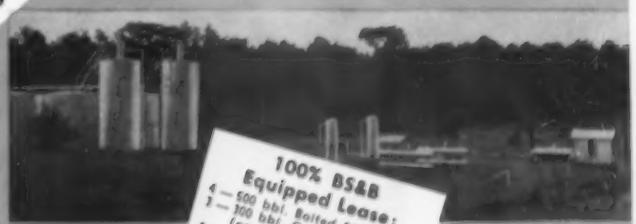

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VOL. 26, NO. 5, MAY, 1955

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THIS MONTH'S COVER

Snow is constantly swept off drill pipe during Winter operations in Western Canada. If a sudden warm Chinook wind melted the snow, the pipe would be frozen into a solid mass of ice when the wind shifted its direction. Photos are by Ulric Meisel for The Texas Company and color plates are reproduced through the courtesy of Ellis Prudden, Editor of *The Texaco Star*.

Tuesday night, September 28th: the Lummus initial operating team first fed oil into the crude unit of the 30,000 B/D refinery which Lummus designed, engineered and constructed for a major oil company at Mandan, North Dakota.

Wednesday night, September 29th: oil was fed into the fluid catalytic cracking unit.

Friday night, October 1st: the entire refinery was in operation at two-thirds capacity, with products going to storage.

Mandan refinery starts up in three days

The Mandan refinery was completed ahead of schedule, started up in record time, and has been operating ever since. It is an integrated plant including crude distillation section, fluid catalytic cracking unit, vapor recovery section, polymerization unit, treating and blending sections and desalter.

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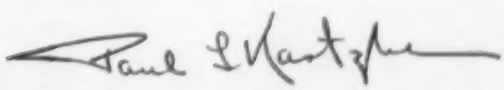
A competitive future

CANADA IN 1955 continues to hold the interest and require the effort of a major portion of the oil industry in its never-ending search for additional oil and gas reserves. Some 200,000,000 acres of land are undergoing exploration and development, 150 geophysical parties and 260 drilling rigs are busy. The industry in 1954 spent in excess of $400,000,000 in exploration and development and added 450,000,000 barrels of oil and 2 trillion cubic feet of gas to the known reserves of Canada. These activities and results are the indications of a vigorous, healthy industry at work, optimistic of the prospects and confident of its ability to discover and produce the desired oil and gas.

Other problems, however, now appear on the horizon. In its recent, rapid seven-year growth period Canada has developed potential oil production which would make it self-sufficient if the need should arise, and has developed a substantial exportable surplus of gas. These two facts alone have posed problems that have never before been faced by the oil industry in Canada. If our oil industry is to continue to grow, we must compete for markets with other producing countries of the world. Always before we have enjoyed geographical and political advantages over most of our competitors. Now we must engage in the free and sometimes rough competition of the open market place.

In order to meet these new problems the industry must make certain its plans are well founded, efficiently carried out, and the results carefully reviewed. The Canadian public through all branches of their government have an equally important role to play at this critical time. They must establish and maintain an atmosphere in which this technical, expensive, high risk industry can flourish in an international market. Private enterprise, which seems clearly to be the best and most efficient economy yet developed, must be encouraged by being subjected to a minimum of restrictions and regulations. If this climate prevails there is no doubt that Canada's oil industry can earn its place in the competitive future and Canada's people will reap the great benefits to be derived from a highly efficient and productive oil industry.



Vice President, Shell Oil Company,
Chairman of The Board of Governors
of The Canadian Petroleum Association.

CANADIAN OIL — 1954

By J. G. Livingstone* and
W. D. Archbold**

THE CANADIAN OIL INDUSTRY again in 1954 experienced a substantial increase in demand, and a growing proportion of this demand was supplied from domestic sources. Consumption of some 555,000 barrels daily exceeded 1953 requirements by nearly nine percent. Crude production increased by 20 percent to 265,000 barrels daily, equivalent to nearly one half of demand, and three fifths of refinery runs. The latter were up 10 percent to 465,000 barrels daily, and supplied 83 percent of Canadian demand. The growth in crude production and refinery operations resulted in a substantial drop of 13,000 barrels daily in crude and product imports. The combination of all these factors has meant another successful year for the Canadian petroleum industry.

In the post-war period this pattern of strong growth has been uninterrupted. Since 1946, for example, demand has increased by over 150 percent or at a rate exceeding 12 percent a year. Many factors have contributed to this record. One of the most important, undoubtedly, is the expansion and diversification of the economy in recent years. Canada's gross national product in 1954 was nearly 24 billion dollars, an increase in real terms of one third since the war. In the same period, the country's external trade was increased by a similar proportion to $10.7 billions, while investment in 1954 of $5.5 billions was, in real terms, more than double the 1946 rate. The population, too, has expanded rapidly with the 1954 level of 15.2 millions exceeding 1946 by 25 percent.

This expansion of the economy has been accomplished in part through diversification. As a result, today the proportion of the labor force employed in manufacturing, for instance, is about the same as that in the United States, or about one fourth. Natural resource developments have also been prominent, with the large scale discoveries of crude oil and natural gas in the West, and iron ore in the East being among the more notable of these. Since modern industrial economies require large quantities of energy for their operation and growth, the post-war developments in the economy have been instrumental in creating large energy demands.

At the same time, the rising standard of living that has accompanied the shift toward more effective utilization of manpower through large scale mechanization has created an increased appetite for modern energy-consuming devices such as automobiles and oil-burners.

A second factor in the oil industry's growth has been the regional nature of the country and the relative availability of the various energy-yielding fuels in these regions. Geographic barriers such as the Rocky Mountains, weather (which freezes waterways several months each year), and distance with its influence on transportation costs, have combined to create four fairly distinct economic areas. Largest of these is the highly-industrialized well-populated central region of Ontario and Quebec. Next in size is the Prairie area, where the bulk of Canada's crude petroleum and agricultural developments have occurred. Finally, there are the two smaller coastal areas, dependent largely on international trade and resource development.

Of the major energy sources, only water power is generally available from local sources in all regions, though somewhat limited in much of the Prairie area. Coal is found in commercial quantities only in the Prairies and on the East Coast, in both cases over a thousand miles from major markets. Natural gas is found largely in the western part of the Prairies, although relatively small reserves exist in both Southwestern Ontario and New Brunswick. Crude oil likewise exists in the same general areas as natural gas. In the case of both natural gas and crude oil, a large proportion of the reserves in Western Canada have been discovered in the last eight years.

In addition to these domestic energy sources, some imported natural gas has been available for some time to supplement local supplies in Ontario, and recently a 20-inch line was completed from Buffalo to Toronto. The large reserves of coal in an area stretching from Pennsylvania to Illinois have supplied a major part of the requirements for this fuel, particularly in Ontario and Quebec. Both crude oil and petroleum products have

*Manager, Co-ordination and Economics Department, Imperial Oil Ltd., Toronto.

**Assistant Manager, Co-ordination and Economics Department, Imperial Oil Ltd., Toronto.

◀ *Facing page: Drilling Shell-Home Sarcee No. 1 just south of the city of Calgary. Shell photo.*

been imported from the United States, the Caribbean and the Middle East for many years.

The tremendous distances which must be covered in Canada, larger even than those in the United States, have made efficient transportation a vital factor in both the location of industry and in the relative success of the various competing fuels.

Finally, there is the weather. In Canada, the winters are long and severe in much of the country as a result of its northern location. This entails high fuel consumption for heating alone. At the same time, the vastness of the country lessens the effect of abnormal weather patterns which seldom are sustained through all areas. The effects of the continuous wet weather in the Prairies during the spring and summer of 1954, for example, were offset in part by excellent weather in other areas.

These, then, are the factors which have shaped post-war oil demands: continued economic growth and diversification, rising standards of living and energy consumption, the transportation problems arising from distance and the regional nature of the economy, the degree of availability of other forms of energy, and finally, the weather. Of these, transportation bears special emphasis because the successful solution of problems in this field has provided much of the basis for oil's post-war expansion. This becomes clear when it is remembered that of the various fuels only water power is generally available in Canada near the major consuming areas. Coal and natural gas, which are both as remote from markets as oil, require little processing after initial production. Oil, on the other hand, must undergo expensive refining before entering the market-place. Therefore, growth in petroleum demand outside local producing areas entails, of necessity, efficient transportation. In the United States this problem is modified by the accessibility of major markets through year-round water transportation, either ocean or river and canal. Only the mid-west has the handicap of winter freeze-up of waterways. In Canada, on the other hand, less than 20 percent of petroleum demand lies in the coastal areas, the only areas with year-round water transportation. This means we must have efficient land transportation, a need that has been filled by long-distance pipe lines.

The post-war development of the oil industry has occurred at a time when coal was high-cost, hydro power was being used to the limits of its current availability in industrial areas, and natural gas was limited in supply. Prior to the discovery of crude oil in Western Canada, the petroleum industry was also a high-cost industry dependent on expensive transportation of imported crude oil or products in inland areas. This outlook was changed by the crude oil discoveries beginning in 1947, following, as they did, the war-time development of long-distance pipe line knowledge. In the next six years pipe lines were constructed to carry the mounting production of crude oil from the Prairies to Vancouver and to Ontario. Refineries were built or expanded along the way and the transportation savings which resulted stimulated the demand for oil production. In 1949, the last year before extensive pipe line facilities became available, crude and products demand in Canada was 320,000 barrels daily. In five years, demand has grown about 75 percent for the country as a whole, or over 11 percent a year. However, in achieving this, the rate of growth in Ontario, Quebec and the Prairies has been nearly 85 percent. The two coastal areas, which had been more fully developed in earlier years, experienced growth of about 50 percent in oil consumption. At the same time, the country's refinery capacity has increased by 68 percent; slightly over 40 percent in the coastal areas, but nearly 73 percent in the interior. As a result of this general growth, per capita demand from Ontario to British Columbia exceeds the national average of 13.4 barrels, while Quebec and the East coast lag somewhat behind.

Thus far the discussion has dealt in general terms with the overall growth in demand and the specific Canadian situations which have accentuated this growth. Along with these special situations has come a general expansion in the ownership of petroleum consuming equipment. Motor vehicle registrations have risen by more than one-half in five years:

Year	Motor Vehicles	Tractors
1949	2,291	323
1950	2,601	365
1951	2,868	404
1952	3,157	436
1953	3,432	461
1954	3,604	478

The number of homes heated by oil has more than doubled in the same period. The railroads have installed large numbers of oil-burning locomotives and are now well along on their dieselization programs. By the end of 1954 over 1,300 of the approximately 5,000 locomotives in the country were diesels, while about 600 more were of the oil-fired steam type.

These factors, and those previously mentioned, have had their effect on demand for the various petroleum products. The following table indicates the level of motor gasoline consumption for each of the last six years:

Year	Thousands of Barrels
1949	45,791
1950	49,988
1951	55,156
1952	62,275
1953	67,637
1954	70,356

The rapid increase in motor vehicle registrations and in farm mechanization is reflected here in a five-year growth of 54 percent.

The most dramatic increases have occurred in the home heating field, where two fuels, stove oil and furnace fuel, predominate. Demand for these fuels has nearly tripled as illustrated in the following table. Throughout most of this period the winters have been extremely mild, falling, in some instances, more than 10 percent below normals measured in degree day terms. However, in 1954, near-normal weather was experienced, particularly in the major consuming areas of Central Canada.

		Consumption	
Year	Oil Heated Homes (Thousands)	Stove Oil (Thousands of Bbls.)	Furnace Fuel
1949	*	5,544	9,829
1950	633	7,197	14,150
1951	774	9,038	18,390
1952	944	8,987	22,553
1953	1,260	10,175	25,852
1954	1,417	11,478	32,865

The demand for heavy fuel oil has been stimulated by the lack of competitive fuels or by their high cost. As a result, much of the post-war industrial expansion has been based on residual fuel. In addition, heavy fuel oil has increased in use as an industrial heating fuel. Expanding post-war trade has created a growing requirement for bunker fuel for ships. The table shows the successive growth in heavy fuel requirements which has yielded a five-year increase in excess of 60 percent, despite a slackening in industrial activity and in international trade, and a decline in railway usage in 1954:

Year	Thousands of Bbls.
1949	24,520
1950	29,106
1951	34,578
1952	35,908
1953	38,845
1954	39,405

A four percent increase in motor gasoline demand and a one percent growth in heavy fuel oil requirements and reasonable growth in most minor products, combined with a substantial 21 percent increase in the demand for middle distillates to provide the nine percent growth in 1954 demand, and to continue the rapid post-war expansion in petroleum consumption in Canada.

The 1954 regional demand picture which yielded these national results is presented in Table I (page 122).

It can be seen that three fifths of Canadian demand is in the Ontario/Quebec area, one fifth in the Prairies, with the remaining fifth divided about equally between the two coastal areas. Of particular importance is the relationship between gasoline and middle distillate demands. It will be noted that the two are essentially equal in all areas except the Prairies. In addition, middle distillate requirements are continuing to grow to a rate substantially in excess of those for gasoline. (Middle distillate growth has been about two and a half times that for gasoline in the post-war period.) When it is considered that, in normal refining operations, it is not possible to produce as much middle distillate as gasoline, a fact of prime importance to the Canadian indus-

(Continued on page 122)

ALBERTA and BRITISH COLUMBIA

A review of 1954 oil discoveries in the two provinces and of drilling, production and reserves in Alberta.

By Dr. Theo. A. Link & John A. Downing

Dr. Link is president and Mr. Downing is vice president of Link, Downing and Cooke Ltd., consulting geologists, Calgary. Dr. Link was formerly chief geologist for Imperial Oil Ltd. Mr. Downing resigned as geologist for Pacific Petroleums Ltd. in 1950 to become associated with Dr. Link. Both authors have been intimately associated with the Western Canadian fields throughout their period of development. Special reports on reserves of various fields prepared by Dr. Link and Mr. Downing were published in 1953 and 1954 Canadian issues.

THE YEAR 1954 was one of steady expansion for the oil industry in Alberta and British Columbia. Production of crude oil in Alberta increased by 14 percent over that of 1953, and although total drilling footage decreased, exploratory drilling increased slightly. The exploratory effort resulted in several interesting oil discoveries, but so far as is known at present, no major oil fields. The recoverable oil reserves of Alberta increased by 70 million barrels for a total over 3,400 million barrels. The increase was due largely to the westward extension of the Pembina field.

The oil discoveries were made in sediments of nearly all age groups but the most significant were in Cambrian (or pre-Devonian), Mississippian, Triassic and Cretaceous sediments. The most important of these were:

POOL	AGE
Gilwood, Alberta	Cambrian
Clear Hills, Alberta	Cambrian
Sundre, Alberta	Mississippian
Westward Ho, Alberta	Mississippian
Buffalo Lake, Alberta	Triassic
Boundary Lake, B.C.	Triassic
Ferrier, Alberta	Cretaceous
Halfway River, B.C.	Cretaceous

This review includes résumés of production, drilling activity, the remaining primary oil reserves of major and intermediate fields and a review of the oil discoveries of 1954 in Alberta and British Columbia. Maps indicating the distribution, thickness and general distribution of the Mississippian and Triassic sediments in Alberta and British Columbia are included, together with a short discussion of the Pembina field.

Crude Oil Production

During 1954 Alberta's total crude oil production amounted to 87,713,855 barrels having a gross value of $227,877,548. A total of 5,070 producing oil wells were in operation during the year; these produced at an approximate average rate of 40 barrels per well per day. Almost 83 percent of the Province's total yearly oil production was taken from seven fields, and 50 percent of the total was produced from the Redwater and Leduc-Woodbend fields. The production from the seven fields in order of magnitude is shown in Table I on the following page.

The Pembina field, which is believed to contain the largest recoverable crude oil reserves in the Province, is still in the early stages of development. Its production in 1954 was 800,404 barrels as compared to 39,272 barrels in 1953. During the next few years it is expected to take its place with the Redwater and Leduc-Woodbend fields as a major source of crude oil.

A comparison of the yearly crude oil production of Alberta during the years 1952 to 1954 indicates that the average yearly production increase is in the order of 23 percent.

YEAR	CRUDE OIL PRODUCTION STOCK TANK BARRELS (NEAREST 1,000)	PERCENTAGE INCREASE
1950	28,378,000	
1951	46,377,000	75
1952	60,617,000	28
1953	76,816,000	27
1954	87,714,000	14

As available markets become saturated and as increased production becomes dependent on the annual increase in consumption, this increase in yearly production will undoubtedly level off at a smaller percentage increase. Canadian markets consumed the major part of the crude oil production during 1954, and a similar ratio will probably apply for the next few years, although the Puget

Horse frees this auto from the mud during road construction work at Pembina. Stanolind photo.

Figure 1.

TABLE I
PRODUCTION OF SEVEN PRINCIPAL ALBERTA FIELDS

Field	Producing Horizon	1954* Crude Oil Production Stock Tank Barrels	Gravity of Crude API
Redwater	Leduc	24,895,984	33°-36°
Leduc-Woodbend	Leduc, Nisku & some Cretaceous	20,560,789	35°-42°
Bonnie Glen	Leduc	6,960,330	35°-43°
Fenn-Big Valley	Nisku & Leduc	6,492,733	30°-34°
Joarcam	Viking	4,858,380	36°-38°
Wizard Lake	Leduc	3,706,921	38°
Golden Spike	Leduc & Nisku	2,549,518	36°-38.3°
Turner Valley	Mississippian	2,137,907	37°-41°

* — Alberta Oil & Gas Industry Monthly Report—P. & N.G. Conservation Board.
** — Leduc and Nisku — Upper Devonian members.
*** — Viking — Cretaceous member.

TABLE II
DISPOSITION OF ALBERTA CRUDE

	1953		1954	
	Barrels	% of Total	Barrels	% of Total
Alberta Refineries	20,942,087	30.0	20,160,523	22.4
British Columbia	2,680,024	3.8	13,463,944	15.0
Saskatchewan	14,372,308	20.6	13,707,955	15.3
Manitoba	5,541,097	8.0	5,218,805	5.8
Ontario	23,438,508	33.6	34,116,343	38.0
USA — Great Lakes	2,191,513	3.1	1,664,991	1.9
USA — Puget Sound	nil	0.0	909,053	1.0
Miscellaneous	512,665	0.9	514,346	0.6
Totals	69,678,202	100.0	89,755,960	100.0

TABLE III
ALBERTA DRILLING ACTIVITIES

Year	Development Drilling (feet)	Exploratory Drilling (Outpost, Deep Pool, Wildcat) (feet)	Total Footage	Total No. of Wells	Average (per well in feet)
1951	3,294,389	1,823,972	5,118,361	1,197	4,275
1952	4,662,191	2,351,361	7,013,552	1,619	4,340
1953	4,263,454	2,090,251	6,353,705	1,426	4,455
1954	3,207,841	2,466,918	5,674,759	1,153	4,940

Sound market will very likely increase its yearly consumption of Alberta crude. This disposition of Alberta crude oil during 1954 and comparative figures for 1953 are shown in Table II.

Drilling Activity

During 1954 total drilling activity decreased, although more exploratory footage was drilled than in any previous year. The decrease in the total activity was due mainly to a decrease in development drilling in the major fields (except Pembina). The shift of a good part of the exploratory activity into the deeper parts of the Alberta geosyncline and the consequent deeper drilling accounts for the increased exploratory footage. A comparison of the annual drilling activity in Alberta for the years 1951-54 is shown in Table III.

Major and Intermediate Fields

No major or intermediate fields were discovered during 1954, although several discoveries have excellent prospects of developing into either of these categories. However, it is not possible to estimate the magnitude of these discoveries since too few data are known. To date, 12 oil fields or pools in Alberta account for the major part of the recoverable crude oil reserves. Eight of these are major fields with original recoverable reserves of 100 million barrels or more. A résumé of these fields showing the productive horizons, the estimated original recoverable oil and other data is shown in Table IV.

Alberta & B. C. Oil Discoveries

Thirty-six wildcat, outpost and deeper pool tests discovered oil in Alberta and British Columbia during 1954 and in January of 1955. The majority of these discoveries was made in wildcat wells. Nineteen of these discovered oil in Cretaceous sediments, but none of the Cretaceous discoveries has more than fair prospects of developing into major or intermediate pools. However, in the aggregate they may produce considerable quantities of oil. The other discovery wells encountered oil in sediments of Cambrian (or Pre-Devonian), Devonian, Mississippian, Permo-Pennsylvanian, Triassic and Jurassic ages. The various horizons are discussed in the following paragraphs.

CAMBRIAN (OR PRE-DEVONIAN):

The first Cambrian oil pool in Alberta was discovered by Great Plains and Associates in the Gilwood district of the Peace River area (April 1954). The discovery well encountered a relatively thin pay section in the "Granite Wash" at a depth of 8,100 feet. The order of magnitude of the recoverable reserves is 500,000 barrels of 39.2°API oil. A second discovery in the same horizon was made by Gulf Oil Co. in the Clear Hills district of the Peace River area (January 1955) 100 miles to the northwest of Gilwood. This well encountered approximately 30 feet of pay at a depth of 6,900 feet. The crude is a light gravity oil (38.7°API) and the pool has reserves in the order of two million barrels. Reserves of both these discoveries may be larger or much larger than is estimated.

DEVONIAN:

Several new pools were discovered in Devonian sediments, but none of these appear to be major accumulations. The discoveries and their pertinent data are summarized in Table V.

MISSISSIPPIAN:

Eight oil discoveries and numerous gas discoveries were made in sediments of Mississippian age during 1954 and the early part of 1955. Mississippian oil and gas production is the most widespread of any geological age group in Western Canada. Figure 2 shows the distribution and thickness of the Mississippian sediments in northeastern British Columbia and Alberta, and the location of the significant Mississippian productive and potentially productive oil and gas pools. Three Mississippian pools discovered in

1954 are significant. Two of them are in the Plains and the third, a gas discovery, is located in the Rocky Mountains:

(1) Sundre: Oil was discovered near the top of the Mississippian sediments in the Sundre area at a depth of 9,150 feet (see Figure 1). The pay thickness is in excess of 70 feet and the discovery well had an initial production of 2,800 b/d. A second well at Westward Ho, 10 miles to the southeast, found Mississippian oil at a comparable depth. Whether these two wells penetrated the same reservoir is not known. If such is the case, the discovery will be the first large oil accumulation in Mississippian sediments east of the Foothills structural province.

(2) Makepeace & Granta: Two wells, six miles apart, drilled by Socony-Vacuum Oil Co., discovered 31°API oil in a fossiliferous zone below the top of the Mississippian-Cretaceous unconformity. The discovery well at Makepeace flowed oil at the rate of 182 b/d. As the majority of the wells producing Mississippian oil in the southern plains of Alberta do so from near the unconformable contact, this new horizon is a significant discovery (see Figure 1).

(3) Savanna Creek: Natural gas in substantial volume was discovered in the Mississippian at a well drilled on the anticipated structure in the Rocky Mountain structural province. This is the first discovery of an appreciable accumulation of hydrocarbons west of the Rocky Mountain front and opens up a good part of the Rocky Mountain area for exploration.

In addition to the above, several smaller Mississippian oil and gas pools were discovered during 1954. However, it is expected that few of these will produce large amounts of oil. Small fields such as Glenevis and Spring Coulee, discovered two to four years ago, have not produced appreciable quantities of oil and Princess, one of the oldest Mississippian oil and gas fields on the plains of Alberta, has not yet produced over one million barrels.

The estimated order of recoverable oil reserves and other data from the Mississippian oil discoveries of 1954 and the first two months of 1955 are shown in Table VI.

TABLE IV
RESERVES OF PRINCIPAL ALBERTA FIELDS

Field or Pool	Wells Capable of Producing	Producing Horizon	Original Recoverable Reserves (S.T. bbls.)	Cumulative Production to end 1954 (nearest 100,000 bbls.)	Remaining Recoverable Reserves (S.T. bbls.)
Pembina	138**	Cardium	1,306,000,000	1,000,000	1,205,000,000
Redwater	922*	Leduc	690,000,000	111,000,000	569,000,000
Bonnie Glen	131*	Leduc	272,000,000	13,300,000	258,700,000
Leduc	711*	Nisku	69,000,000	33,400,000	35,600,000
	538*	Leduc	208,000,000	63,800,000	144,200,000
Wizard Lake	51*	Leduc	154,000,000	8,700,000	145,300,000
Sturgeon Lake (North & South)	16**	Leduc	135,000,000	negligible	135,000,000
Fenn-N. Big Valley	267*	Nisku	112,000,000	9,200,000	102,800,000
Golden Spike	11	Leduc	103,000,000	6,900,000	96,100,000
Joarcam	473*	Viking	80,000,000	12,700,000	67,300,000
Acheson	88*	Leduc	63,000,000	7,700,000	55,300,000
Westerose	19**	Leduc	60,000,000	2,400,000	57,600,000
Stettler	71*	Nisku	25,000,000	2,000,000	23,000,000
West Drumheller	56*	Nisku	19,700,000	1,500,000	18,200,000
Totals			3,296,700,000	273,600,000	3,023,100,000

* — Well Spacing — 40 acres/well.
** — Well Spacing — 80 acres/well.

PERMO-PENNSYLVANIAN

One well discovered oil in the Permo-Pennsylvanian sediments during 1954. This well, Sinclair Banff Buffalo Lake Crown No. 1 (Peace River area, Alberta), found 49°API crude oil and natural gas in section of the "Permo-Penn" at a depth of 7,700 feet. During tests the formation produced substantial amounts of natural gas with some condensate and non-commercial amounts of oil. The well was then plugged back to test the Triassic sediments.

The "Permo-Penn" is a major gas reservoir in the Fort St. John gas field of northeast British Columbia.

TRIASSIC

Several significant discoveries were made in Triassic sediments in Alberta and British Columbia during the year. Since 1950 the Triassic has been one of the major objectives in drilling for natural gas, particularly in northeast British Columbia. The Triassic forms the reservoir for the major part of the gas reserves in the Fort St. John field and in various other gas fields in Alberta and British Columbia. Sediments of this age group will undoubtedly supply a major part of the natural gas for the West Coast Transmission Co. The accompanying map (Figure 2, next page) shows the distribution and thickness of the Triassic sediments and the most significant oil and gas fields discovered to date.

The two most important oil discoveries in the Triassic during 1954 are currently one-well pools only. The discovery wells are N.F.A. Texaco Boundary Lake No. 1 (British Columbia), and Sinclair Banff Buffalo Lake Crown No. 1 (Alberta). The former had an I.P. of 242 b/d of 35°API crude and the latter 70 b/d of 29°API crude.

POOL	DEPTH	ORDER OF THICKNESS OF PAY (FEET)	ORDER OF RECOVERABLE RESERVES (BBLS)
Boundary Lake	4,400	30	5,000
Buffalo Lake	6,100	15	1,000
			6,000

JURASSIC

One well reported encountering gas and oil in the Jurassic sediments. This well, Socony Seaboard Violet Grove No. 706, was a deeper pool test in the Pembina field. A drill stem test of the porous Jurassic sediments gave a glow of gas and a moderate recovery of clean oil.

TABLE V
1954 ALBERTA DISCOVERIES

Pool or Field	Reservoir	Order of Thickness of Pay	Depth (feet)	Order of Recoverable Reserves (barrels)	Gravity of Crude (API)
Caroline	Wabamun	..	10,100	.....	Naphtha
Medin	Nisku	25'		1,000,000	44°
Blue Ridge	Nisku	15'	6,030	100,000	37°
Acme	Nisku	10'	7,000	100,000	39°
Wimborne	Leduc	15'	7,450	200,000	38°
Woodbend	Leduc	10'	5,750	100,000	41°
Nestow	Leduc	10'	3,450	100,000	12°
Cooking Lake	Nisku	10'	4,100	100,000	35.8°
				1,700,000	

TABLE VI
RECOVERABLE OIL FROM 1954 MISSISSIPPIAN DISCOVERIES

Pool	Order of Thickness of Pay	Depth (feet)	Order of Recoverable Reserves (barrels)	Gravity of Crude API
Granta	10'	4,200	500,000	25°-28°
Makepeace	20'	4,500	1,000,000*	31°
Medin	30'	7,200	1,000,000*	28.4°
Sundre	70'	9,150	5,000,000*	28°
Westward Ho	70'	8,800	5,000,000*	35.2°
Blue Ridge	10'	4,700	100,000	25°
Greencourt	10'	5,000	100,000	20°
Buck Creek	10'	6,750	100,000	35.2°
			12,800,000	

* — Could be larger or much larger.

TABLE VII

1954 CRETACEOUS DISCOVERIES

Field	Reservoir	Order of Thickness of Pay	Depth (feet)	Order of Recoverable Reserves (barrels)	Approx. Gravity of Oil API
Alberta					
Manyberries	Lower Cret.*	10′	4,100	100,000	45°
Cecil	Lower Cret.	10′	3,100	100,000	21°
Brooks	Lower Cret.	10′	3,750	300,000	25°
Jenner	Lower Cret.	10′	3,300	100,000	17°
Heathdale	Lower Cret.	10′	3,650	100,000	medium
Wayne	Lower Cret.	10′	4,500	500,000	29°
N. Drumheller	Lower Cret.	10′	4,400	100,000	24°
Pine	Lower Cret.	10′	4,900	100,000	30°
East Kessler	Viking	10′	2,470	200,000	35°
Pigeon Lake	Cardium	10′	4,500	500,000*	34°
Bretona	Lower Cret.	10′	3,900	100,000	32°
Garrington	Cardium	10′	6,950	1,000,000	39.8°
Leslieville	Cardium	10′	6,200	1,000,000**	42°
Alhambra	Cardium	10′	6,100	1,000,000**	40°
Rocky Mtn. House	Cardium	20′	6,000	5,000,000**	39.5°
Ferrier	Viking	10′	8,200	500,000**	40.8°
Peers	Viking	10′	6,100	500,000	34.3°
Granada	Lower Cret.	10′	6,000	100,000	38°
W. Hamilton Lake	Viking	10′	3,000	100,000	35°
Buck Lake (Seaboard)	Belly River	10′	4,400	200,000	36.2°
Buck Creek (Imperial)	Belly River	10′	3,600	100,000	38°
Thunder Lake	Detrital	5-10′	4,000	500,000	28°
				12,200,000	
British Columbia					
Halfway	Cadomin	10′	2,900	500,000	45°
Buick Creek	Nikanassin	5′	4,100	100,000	light gravity
				600,000	

* — Lower Cretaceous—In nearly all discovery wells in Alberta the oil pay is a sandstone at the base of the Cretaceous sediments, known as the Ellerslie, Basal Quartz, Sunburst or by various other names.

** — Could be larger or much larger.

Figure 2.

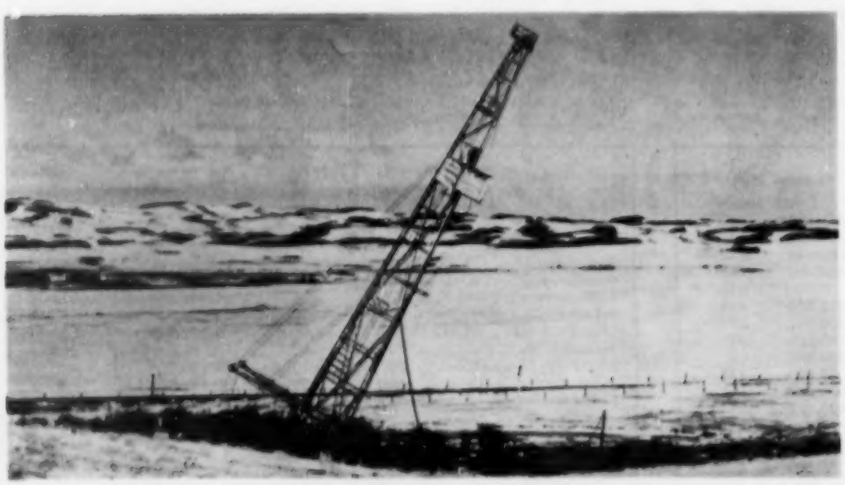
CRETACEOUS

As previously mentioned, the majority of the oil discoveries in Alberta and British Columbia have been made in Cretaceous sediments. These discoveries (see Table VII) are as yet largely one- or two-well pools and consequently very little is known of their recoverable reserves.

Pembina

During 1954, despite adverse weather conditions, development of the Pembina field continued at a high rate. In addition, the general Pembina area underwent a substantial amount of exploratory drilling, resulting in the general definition of the north and southeast limits of the field. To date, however, the west and southwest limits of the field have not been defined by drilling, and extension wells in these directions have not yet indicated the presence of a donwflank water table in the producing reservoir of the field. The oil column in the Cardium sandstone at Pembina currently extends through 964 feet, from a high of 1,815 feet subsea on the east to a low of

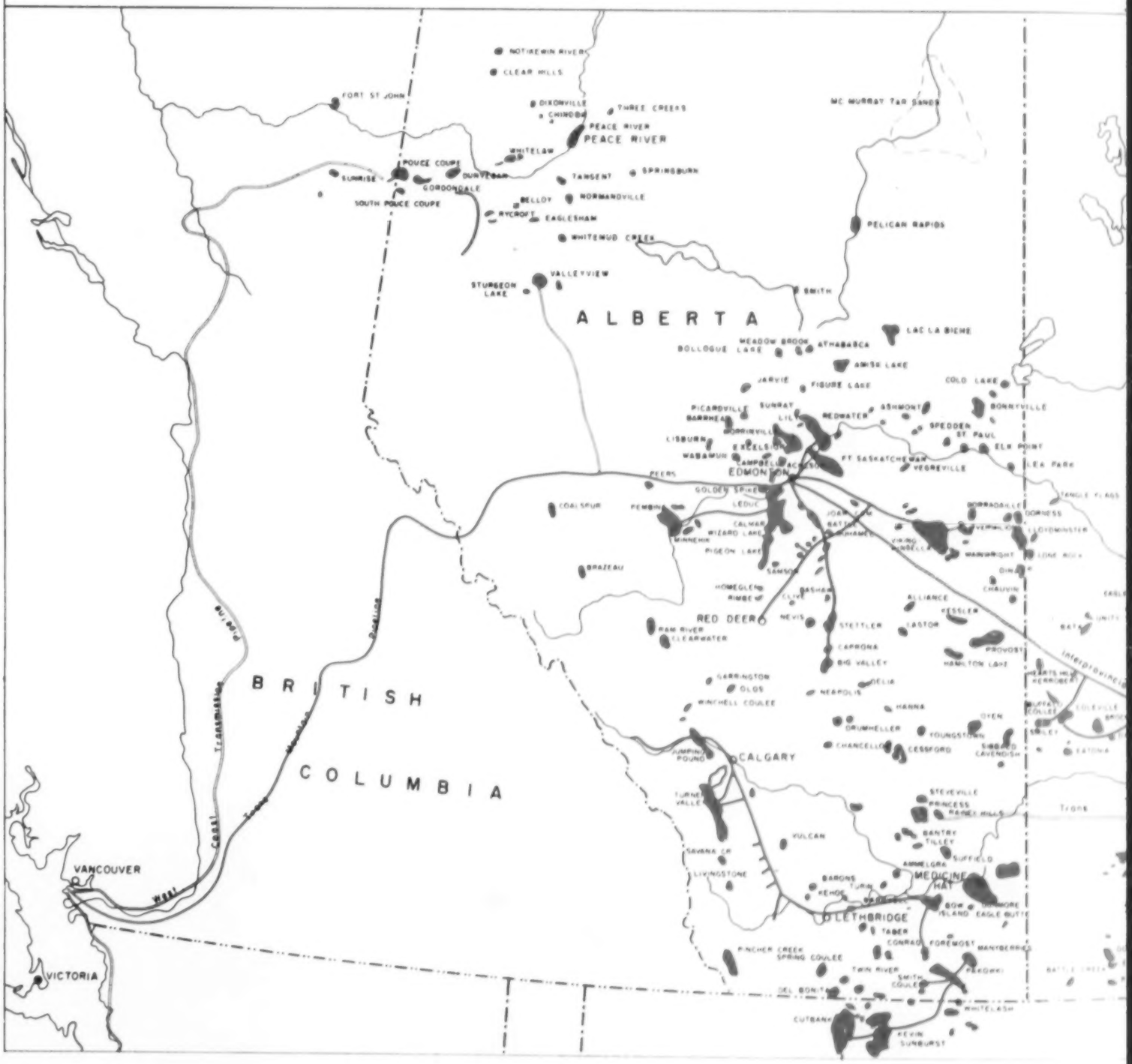
Raising the mast on Shell Caprona A-2. This field, producing from the Devonian, is located in central Alberta in the area between Drumheller and Stettler, about 100 air miles northeast of Calgary.



These roughnecks at an Imperial Oil wildcat are garbed for warmth and safety in 60 below zero temperatures. The rig is boarded in for protection from freezing winds.

WORLD PETR

MAP OF WESTERN CANADA C

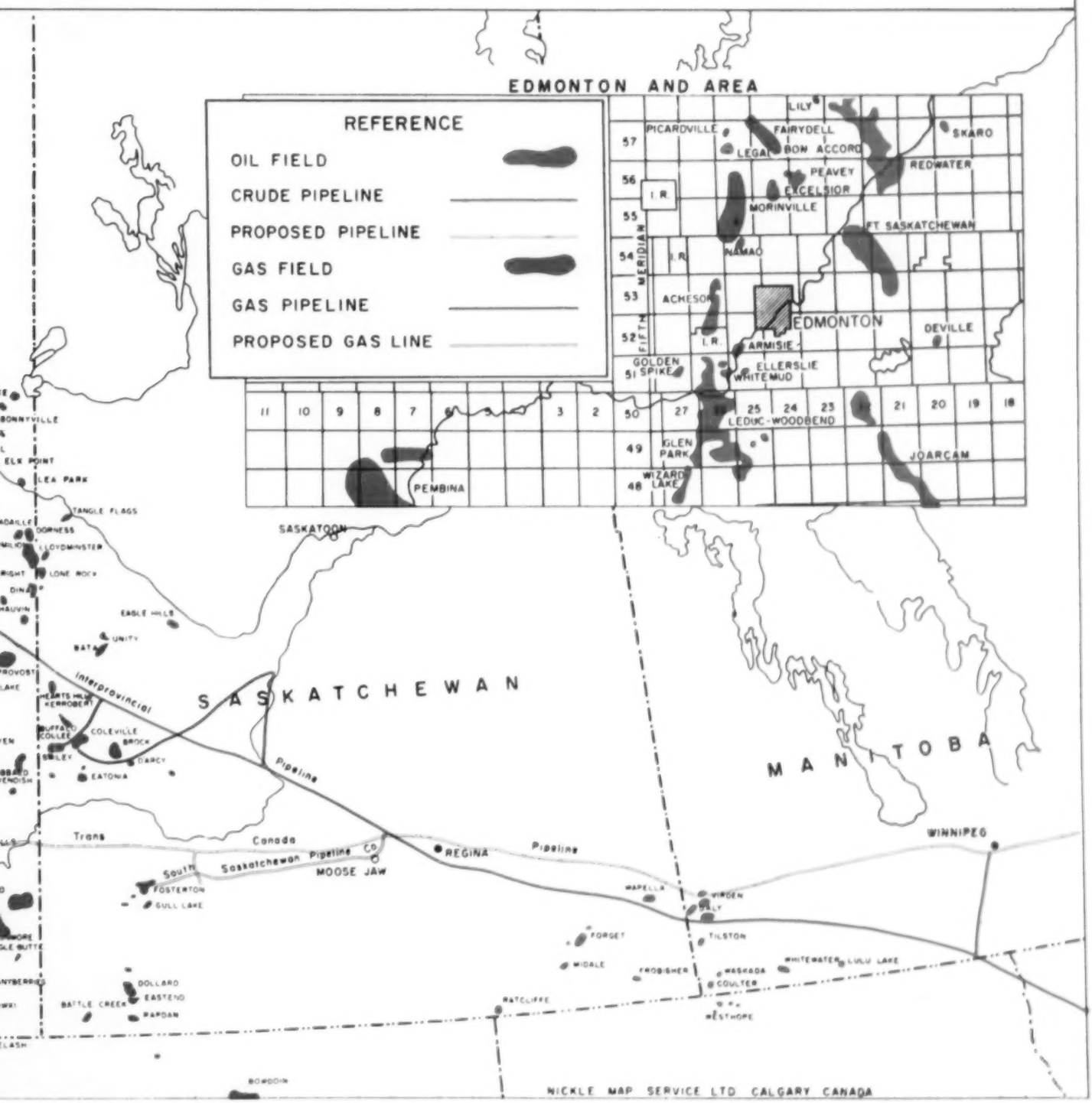


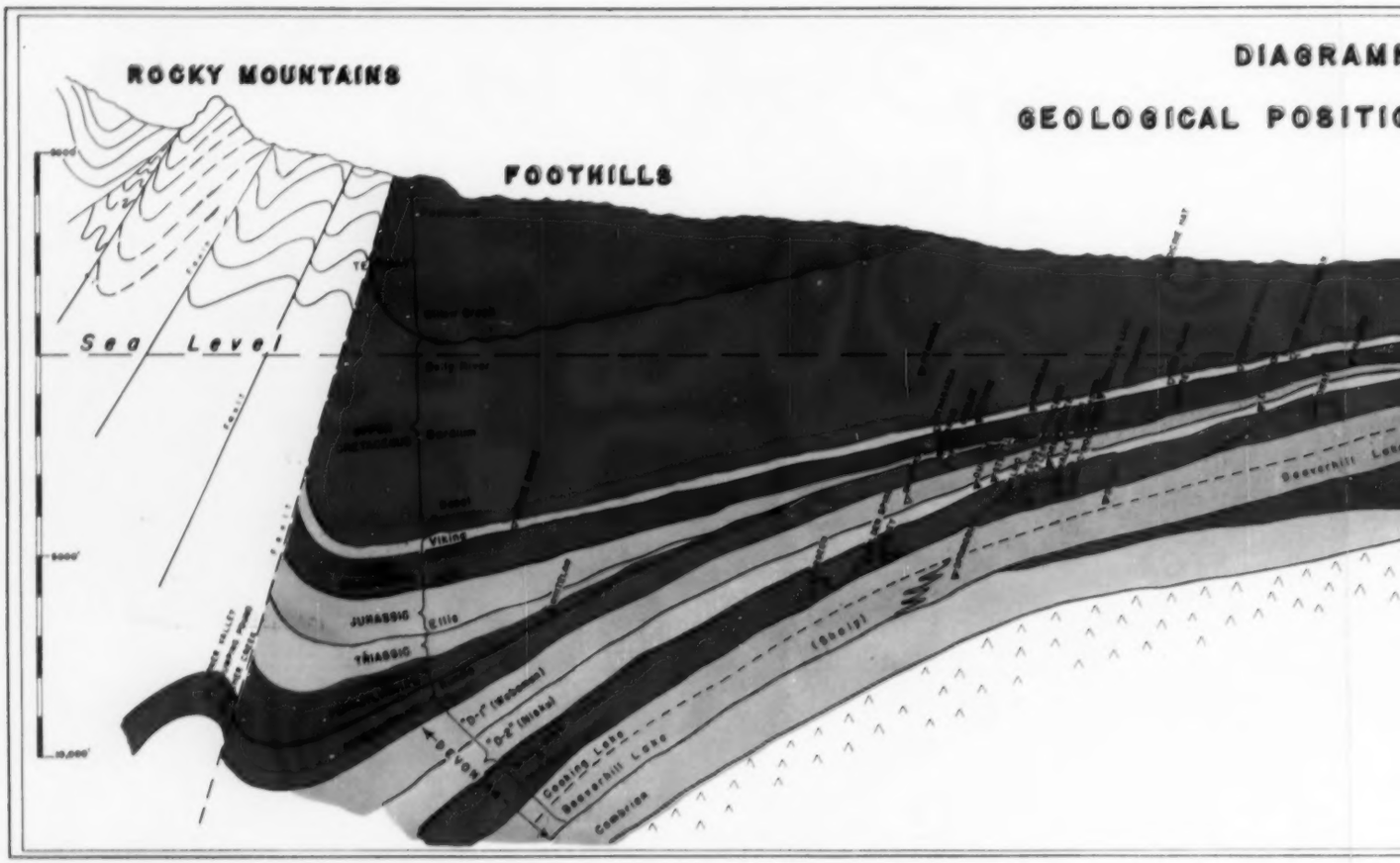
WORLD PE

MAP OF WESTERN CANAD

ETROLEUM

ADA OIL AND GAS FIELDS





DIAGRAM

GEOLOGICAL POSITI

OIL AND GAS FIELDS IN ALBERTA

UPPER CRETACEOUS FIELDS

Barons
Bonnyville *
Brooks *
Cessford *
Medicine Hat *
Pembina
Picardville *
Suffield *
Tilley *

LOWER CRETACEOUS FIELDS

Viking Fields

Athabasca *
Battle River
Baxter Lake
Bow Island *
Duvernay *
Elk Point *
Etzikom *
Foremost *
Fort Saskatchewan *
Hamilton Lake
Joarcam
Joffre
Legal
Lindberg *
Manyberries *
Peavey
Pendant D'Oreille *
Picardville *
Pouce Coupe *
Smith Coulee *
St. Paul *
Viking Kinsella *

Blairmore Fields

Acheson
Acheson East
Alliance
Armisie
Bonnyville
Campbell
Cessford
Chamberlain
Chauvin
Cold Lake *
Dina
Ellerslie
Lloydminster
Malmo
Marinville *
Namao
New Norway
Oberlin *
Peavey
Pouce Coupe *
Princess *
Samson
Stettler *
Taber
Vermillion
Wainwright
Whitelaw *
Whitemud
Wildmere*

JURASSIC FIELDS

Black Butte *
Conrad
Pouce Coupe *

PERMO-PENNSYLVANIAN FIELDS

Whitelaw *

MISSISSIPPIAN FIELDS

Barrhead
Del Bonita
Jumping Pound *
Princess
Spring Coulee
Turner Valley
Pincher Creek *

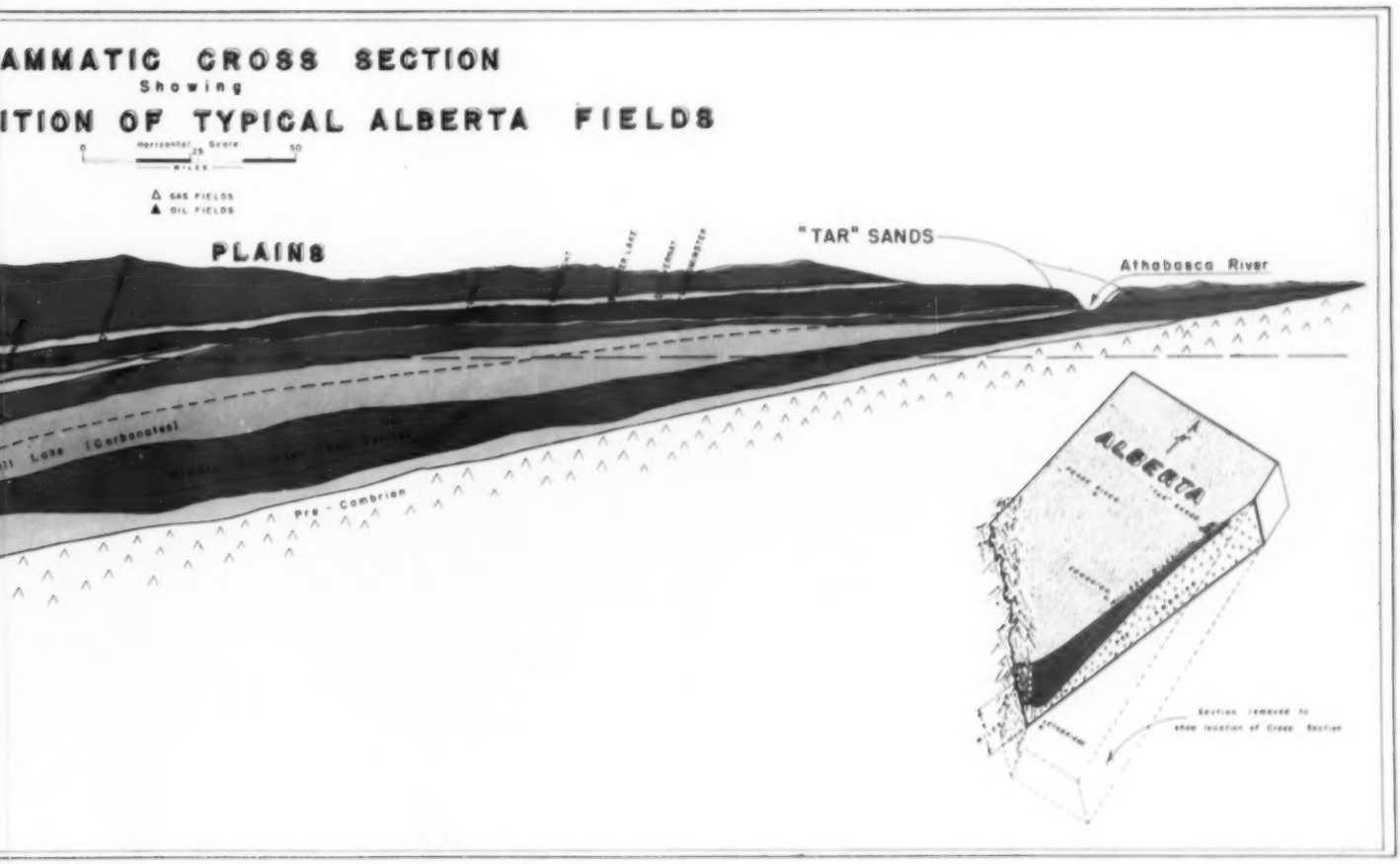
Wabamun

Okotoks

Nisku (D

Acheson
Big Valley
Clive
Drumheller East
Duhamel
Excelsior
Fairydell-Bon Accord
Penn-North Big Valley

*Indicates gas field.



DEVONIAN FIELDS

bamun (D-1)

Okotoks

lisku (D-2)

Glen Park
Golden Spike
Leduc-Woodbend
Malmo
New Norway
Princess
Stettler
West Drumheller

Leduc (D-3)

Acheson
Boshaw
Big Valley
Bonnie Glen
Clive
Duhamel
Erskine
Fairydell
Penn-North
Big Valley
Glen Park
Golden Spike
Leduc-Woodbend
Malmo
New Norway
Normanville
Redwater
Rimbey
St. Albert
Stettler
Sturgeon Lake
West Drumheller
Westerose
Wizard Lake

Cooking Lake

Skara

Beaverhill Lake

Springburn

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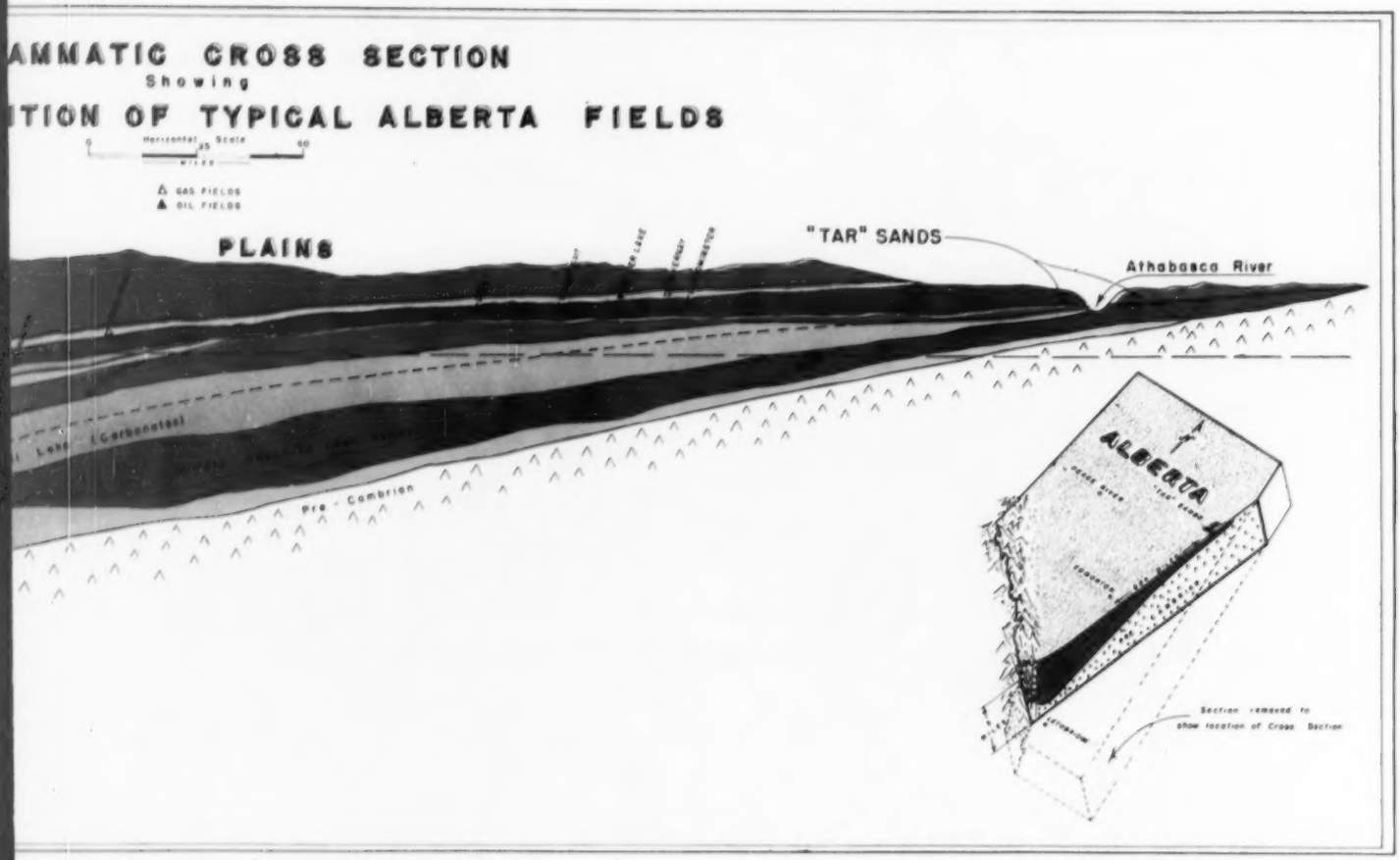

DEVONIAN FIELDS

mun (D-1)

Okotoks

ku (D-2)

Glen Park
Golden Spike
Leduc-Woodbend
Malmo
New Norway
Princess
Stettler
West Drumheller

Achesan
Bashaw
Big Valley
Bonnie Glen
Clive
Duhamel
Erskine
Fairydell
Penn-North
Big Valley
Glen Park
Golden Spike
Leduc-Woodbend
Malmo
New Norway

Leduc (D-3)

Normanville
Redwater
Rimbey
St. Albert
Stettler
Sturgeon Lake
West Drumheller
Westerose
Wizard Lake

Cooking Lake

Skara

Beaverhill Lake

Springburn

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2,779 feet subsea on the west. At the present time the field extends some 28 miles in a north-south direction and 26 miles in an east-west direction for a proven area of 435,000 acres. The available data indicate that the average effective pay thickness of the Cardium sandstone is 15 feet for an oil recovery of 3,000 barrels per acre. On this basis the original recoverable oil reserves of the field are currently in the order of 1,306,000,000 barrels. To the end of 1954 the total production from the field amounted to approximately one million barrels, leaving a remaining recoverable reserve of 1,305,000,000 barrels.

The well spacing assigned to Cardium productive wells in the field is 80 acres, and at December 31, 1954 a total of 138 wells were capable of production. At March 1, 1955 the number of wells capable of production had increased to 242, indicating the rapid rate of development in the field. The maximum producing rate for Pembina wells has been set at 200 barrels per well per day and the average daily prorated well production is in the order of 117 barrels.

Figure 4.

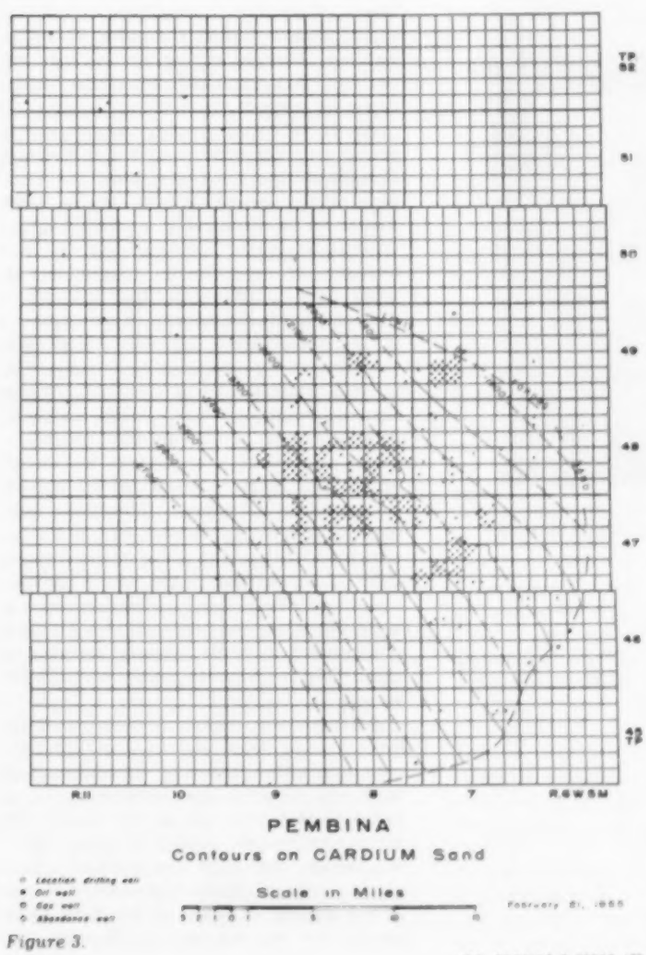


Figure 3.

In 1953 exploratory and development drilling had indicated that the Belly River, Viking and Lower Cretaceous sands and the Madison carbonates were oil and gas reservoirs in the Pembina area. In 1954 additional drilling at depths below the Cardium sandstone has indicated that sandstones of Jurassic age also comprise a possible producing reservoir in the area. A well located in the east central part of the field in Township 48, Range 7, West 5th Meridian, obtained a moderate flow of gas and recovered 600 feet of clean oil on a formation test of a Jurassic sandstone. However, this well has been completed as a Cardium oil producer and the Jurassic oil and gas show awaits further evaluation.

The Pembina field is expected to undergo its greatest period of development during 1955. Substantial amounts of exploratory and development drilling are required to define the actual producing limits of the field, particularly in a westerly downflank direction. The areal extent of the field now surpasses that of the East Texas field and it is probable that future exploratory drilling will prove the field to be considerably larger than is presently known.

Figure 3 indicates the present extent of the Pembina field and Figure 4 shows the field relative to other significant oil and gas discoveries in the Cardium sandstone of Alberta.

William P. Ogilvie, director of Accurate Exploration Ltd., Calgary, spent two summers doing surface geology for California Standard in Alberta before joining the company as a geologist in 1946. He was transferred to the geophysical department a year later and after working in Texas, Manitoba and Alberta he became district geophysicist. He joined Accurate Exploration as a supervisor in 1952.

Geophysical activity in Western Canada—1954

A Stanolind contract seismograph party uses half-track snowmobiles which operate in both snow and muskeg.

Dave Barss, intermediate geologist, uses aerial mosaic in surface geology studies and in picking access routes for seismograph crews. Photos courtesy Stanolind Oil & Gas Co

By William P. Ogilvie

FOR THE SECOND successive year there has been a decline in geophysical activity in Western Canada. The decline represents a reduction by 15 percent of activity from 1953 and 22 percent from the peak year of 1952. The fact that during 1954 a peak month for activity was recorded highlights the increasingly seasonal nature of the exploration effort.

During 1954 the petroleum industry made use of 1,592 crew months of seismograph and gravity meter exploration, compared with 1,877 in 1953 and the record total of 2,042 in 1952. Gravity meter work stayed almost constant, showing a small decline to 97 crew months from 104, but this confirms the earlier reduction in activity from a level of around 150 crew months annually.

In spite of the fact that during March of 1954 more seismograph crews (178) were active in Western Canada than at any previous time, total crew months activity for the year showed a marked decline to 1,495 from the total of 1,773 posted in 1953. This reduction occurred mainly at the expense of prospective areas in Alberta, the crew months for 1954 and the percentage changes by provinces being as follows: Alberta 1,085, down 23 percent; Saskatchewan 304, up eight percent; British Columbia 97, up 31 percent; Northwest Territories four, no earlier work reported; Manitoba three, down 84 percent from 19.

As in 1953, no ground magnetometer crews were reported as active in Western Canada during the report year. At least two of the active gravity crews were known to be equipped as combined gravity-magnetometer parties, but as the amount of specifically magnetometer work done is unknown, their activity is not reflected in the figures. Approximately 100,000 square miles were flown with the airborne magnetometer during 1954 at an estimated cost of $300,000. These figures emphasize the almost complete disappearance of the ground magnetometer as a reconnaissance tool due to the lower unit costs inherent in the use of the airborne instrument. The lower unit costs are achieved, however, only at a considerable total cost and use of the instrument is in general restricted to companies having large land spreads or seeking widespread regional control. It has found much favor as a preliminary reconnaissance tool in remote areas of difficult access.

An unknown amount of work was done during 1954 with airborne scintillation counters, either alone or in conjunction with the airborne magnetometer. It is believed that the bulk of this work was of an experimental nature by firms seeking an evaluation of the method. The results will perhaps be expressed in terms of the amount of work of this type done during the coming season. The savings

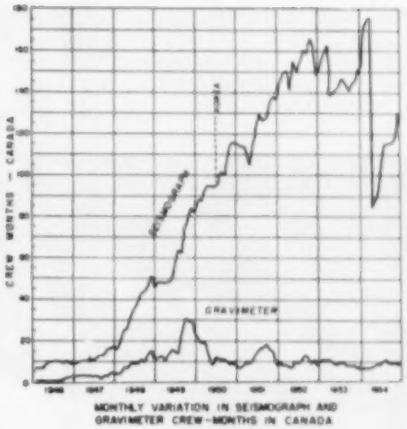
made by combining the radio-active and magnetic tools into a single survey are not as great as might be anticipated because optimum flight level for the magnetic survey is believed to be around 1,000 feet while for the scintillation counter best results are secured at 300 feet or less. It is hoped that the problems raised by this necessary duplication of flight patterns at different elevations will be successfully solved and that the radio-active method will be added to the arsenal of useful tools in Western Canada.

The gravity meter continues largely as a reconnaissance tool in use by firms seeking a broad understanding of regional conditions. In recent years, however, increasing interest has been shown in high station density detail work and a number of companies are known to be making experimental surveys along these lines. More applications for gravity meter work may be found if these experiments are successful, especially in areas such as certain parts of northwestern Alberta where the basement rocks are encountered at moderate depths and where knowledge of the configuration of the basement surface is of great value.

Seismograph exploration has usually been of a seasonal nature in Western Canada. Before the current exploration cycle was started by the discovery of the Leduc Oil field by Imperial Oil in 1947, most companies restricted their geophysical activity to the summer and fall seasons. This policy was continued into the period of increasing activity from 1947 to 1950, when a tendency to postpone the addition of further units until after the spring breakup was evident. This pattern has, especially in the last two years, been altered to one of maximum activity in the months immediately before the spring breakup with a gradual buildup in the number of active crews through the summer and fall. The change, of course, reflects the shift in emphasis of the exploration effort from the plains areas to the remote or inaccessible bush and muskeg country of the north and west.

As will be noted in Figure 2, monthly activity for 1954 exhibits the most extreme variations thus far experienced, active seismograph units dropping from an all-time peak of 178 in March to less than 100 in the immediately following months. This seasonality of the work is not a healthy condition and many firms and individuals are bending their efforts toward its correction.

Work in the great central plains areas of Eastern Alberta and Saskatchewan is difficult and expensive in the winter because of the severity of the frequent blizzards and the resultant difficulty in keeping the roads open. Continuing experiments with the use of tracked equipment has demonstrated the feasibility of winter work under these conditions and the earlier marked exodus of crews from Saskatchewan has been much reduced in the last two years.



MONTHLY VARIATION IN SEISMOGRAPH AND GRAVIMETER CREW-MONTHS IN CANADA

Worker unreels jug-line in flier's boots and hooded parka.

TABLE I

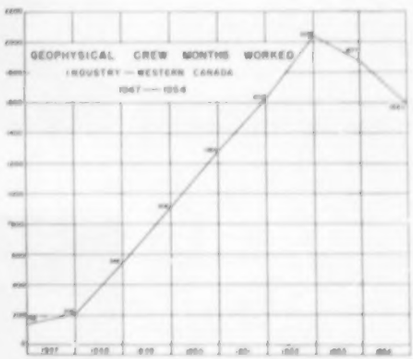
GEOPHYSICAL ACTIVITY — CREW MONTHS — WESTERN CANADA*

	Seismic			Gravity			Magnetometer			Total		
	1954	1953	1947	1954	1953	1947	1953-54	1952	1947	1954	1953	1947
Alberta	1085	1406	155	65	75	41	—	3	7	1150	1481	203
Saskatchewan	304	281	—	24	24	—	—	26	—	328	305	—
Manitoba	3	19	6	8	—	—	—	6	—	11	19	6
British Columbia	97	67	—	—	5	—	—	3	—	97	72	—
Northwest Terr.	4	—	—	—	—	—	—	9	—	4	—	—
	1495	1773	161	97	104	41	0	47	7	1592	1877	209

* Source: Crew months data for this tabulation and Figures 1 and 2 were obtained from the Committee on Geophysical Activity of the Society of Exploration Geophysicists for the years 1947 and 1953. Data for 1954 were compiled by the author. Figure 1 is reproduced through the courtesy of the editors of *Geophysics*.

By far the most important cause underlying the heavy demand for geophysical units in January, February and March is, however, the fact that no completely satisfactory method of operating in the bush and muskeg country in the summer has been arrived at. The muskeg, which has been aptly described as too thin to walk on and too thick to swim through, can only be crossed safely by heavy equipment during the period of frozen ground. Tracked units capable of traversing the muskeg have been developed and are in use, but in general are limited to effective payloads of 3,000 pounds or less. In areas of difficult drilling, where conventional rather than "light" drills are required, these units are inadequate. Many experiments have been and are continuing to be made and it may well be that designs now in the try-out stage hold the solution to this problem.

Overall expenditure on geophysical effort is estimated to have been $35 million during 1954. This represents a $2 million decrease from 1953 and a $5 million decrease from 1952, but as the cost per crew month has been increasing, the percentage change is not as large as that reflected in the comparison of numbers of crew months. The increase in cost is due primarily to the need for specialized and expensive equipment for use in the brush areas. Cost-per-profile of plains



area work has, however, also increased in large part due to the permit costs of $25 or more a hole imposed by the landowners on detail program.

It is anticipated that during 1955 the overall geophysical activity will again decline, but probably not as far. It is hoped that new techniques and equipment for work in the bush will allow more crews to be kept active during the summer months, but this is problematical. The coming year will also see increased use of new techniques and instrumentation in all fields, including regional radio-active surveys and increased automation in the handling of seismograph data.

Typical terrain in the Peace River area.

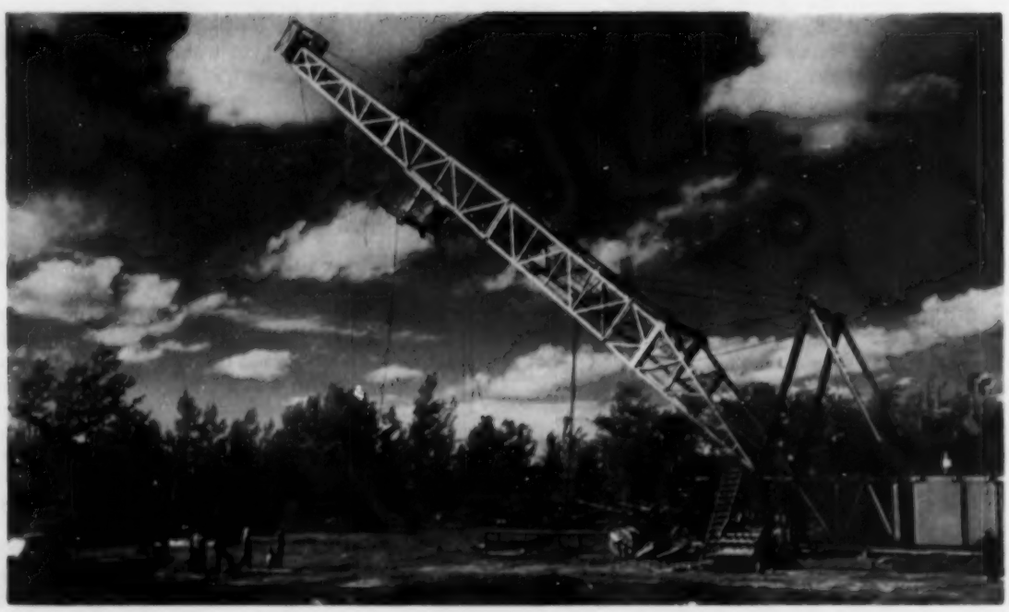
Westcoast Transmission plans deliveries to U.S. in 1956

Frank M. McMahon, chairman, Westcoast Transmission Co.

By Don Tyrell

TWENTY YEARS of planning, hard work and determination are paying off this summer as work starts on the Westcoast Transmission Company's natural gas line from the Peace River districts of British Columbia and Alberta to Vancouver and Northwest cities of the United States.

A natural gas pipe line serving the Pacific Northwest has been planned by Frank McMahon, chairman of Westcoast since 1935. Mr. McMahon, one of the first



Rigging up to drill in the Fort St. John gas field. Photo by Wilfred Doucette, Ottawa.

to back his faith in the petroleum possibilities of B. C. with his own cash, organized Pacific Petroleums, parent company of Westcoast, and the first firm to search for oil and gas in B. C.

Since that time more than $40 million has been spent by Pacific Petroleums and other major firms and expenditures are increasing rapidly.

The Westcoast Transmission pipe line came into being to find a market for the tremendous proven natural gas reserves of Canada's two western provinces. The first actual work on the line started in March when Canadian Bechtel, managers of construction for Westcoast, moved surveyors into the field in the Fraser Valley section between Agassiz and Hope.

When completed, the 30-inch line will be 650 miles long. With gathering lines and compressor stations, the cost will be $140 million. As many as 2,000 will be employed to build the line. Bechtel and Westcoast have specified that Canadian workers will be employed where possible. With this in view, the Vocational Trade School at Vancouver has been teaching pipe line welding techniques to skilled welders who already hold first class welding tickets. Construction will start this summer with completion and first delivery of gas set for 1956.

General headquarters for the operation are in Vancouver, where Canadian Bechtel, Ford, Bacon & Davis, Inc. (engineers for Westcoast) and Westcoast have set up offices.

Incorporated in 1949, Westcoast, after three years of hearings in Alberta, was granted the right to export northern Alberta gas from the province. A short time later, the Board of Transport Commissioners in Ottawa, which has jurisdiction in across-border and inter-provincial pipe lines, granted Westcoast a franchise to build over the B. C.-Alberta border and to carry its line to Sumas where it would cross the international boundary.

Westcoast then applied to the Federal Power Commission in Washington for the right to carry Canadian gas into the United States. This record-breaking hearing started in June 1952 and ended two years later when the F.P.C. turned down the Westcoast application.

In an agreement signed in December 1954 with Pacific Northwest Pipeline Corporation, the firm which won F.P.C. permission to supply gas to Washington and Oregon, Westcoast will deliver gas to the B.C.-U.S. border at Sumas to Pacific Northwest. Westcoast will supply 300 million cubic feet per day to Pacific Northwest, which will supply gas to El Paso Natural Gas Co.

The international gas transaction still needed formal F.P.C. approval as this is written, but obstacles raised by the commission to the original application as sought by Westcoast are believed to have been overcome. Principal objection voiced by the F.P.C. was that the sole source of supply for the new line would originate in a foreign country. Under the new arrangement, the gas supplied by Westcoast will be only a portion of that used in the new lines. Points raised at the Westcoast hearing have been met and backers of the international line are confident it will go through.

Construction schedules for the Westcoast line have now been completed. First delivery of main line pipe, which will come partly from Durham in the United Kingdom and partly from the U.S., will be made in June. Laying of the pipe will start in July with completion scheduled for 1956.

Since the line was first envisaged Westcoast has upped the size of the main line from 24 to 30 inches, with an ultimate capacity of 700 million cubic feet per day, nearly twice that of the original 24-inch line. It is the firm sale of the 300 million cubic feet daily to the U.S. that makes the line possible, as B.C. by itself would use only 50 million cubic feet per day in the initial years.

Starting inside the Alberta border near the Pouce Coupe gas fields, the line is the first of two 30-inchers planned by Westcoast. Gathering lines will fan out over the Peace River districts of B.C. and Alberta. The line will pass through a $3 to $5 million stripping plant near the bridge leading across the Peach River to Fort St. John.

It will go through Pine Pass down to Prince George, carrying on to Quesnel, Williams Lake to Kamloops, then to Merritt, where it will follow a route to the Pacific Coast similar to that taken by the Trans Mountain Oil Pipe Line to Hope through the Fraser Valley to the American border at Sumas and to Vancouver.

Bechtel's construction operations for Westcoast are under the direction of H. V. Waste, vice president of Canadian Bechtel, with J. V. Chambers, administrative manager, and Duane P. Smith, project engineer.

Bechtel, builder of the Trans Mountain line, will supervise all phases of the Westcoast job but will sublet contracts for the actual building which will be done in four or five spreads all working to a Westcoast-set deadline for delivery of natural gas in Vancouver by December 1956.

Contractors expected to bid for a share of work when tenders are called after the F.P.C. ruling are Marwell Construction, Campbell-Bennett and Anderson International of Vancouver. One of the first major jobs will be the clearing of the 60-foot right-of-way from Fort St. John to Vancouver and the U.S. border.

British Columbia Electric Railway Co. Ltd., which presently supplies electricity and manufactured gas to Vancouver and most of the populous lower mainland of B.C., will build the line through the Fraser Valley to Vancouver, where it will replace its manufactured product with the natural gas. The company has been lining up prospects for natural gas sales in the cities and villages along the route from the Fraser Valley into Vancouver.

The second 30-inch line planned by Westcoast would follow a route similar to the one on which construction has started until the two lines reach Merritt. From there the second line would swing south through the Okanagan Valley, where it would serve towns en route to Osoyoos and the U.S. border.

Westcoast officials believe the second line will be needed by 1958 or 1960. The two lines will have a total capacity of more than one billion cubic feet per day.

Another possibility growing out of the coming of natural gas to the lower mainland regions of B.C. is its spread to the prosperous southern end of Vancouver Island. Crews have already surveyed possible routes for a gas line to Victoria, British Columbia's capital city on the island.

Westcoast will allocate gas to any company prepared to supply Victoria. Most logical route to Victoria for natural gas is an island-hopping one from Bellingham, Washington, through the numerous islands of the San Juan and Gulf Island groups.

Gas would pass in bond through the U.S. section of the line. From Bellingham to Victoria is a distance of 50 miles, and one estimated cost of the proposed line is $600,000. A. E. Grauer, president of B.C. Electric, says his company has been studying natural gas for Victoria. One plan is that Westcoast would sell the gas to Cascade Gas of Seattle and B.C. Electric would buy it from that company for distribution in Victoria.

The study of the potential of Victoria as a market for natural gas is a result of the increased gas reserves being proved up continually in the Peace River districts of B.C. and Alberta. These have brought a pressing need for additional markets. Westcoast has already applied to Alberta for a boost in its gas export from that province.

The Peace River sections of B.C. and Alberta are now the hottest areas in Canada for gas and oil exploration. More than 42 drilling rigs are in the area, 34 drilling in wildcat territory in Alberta and 14 in B.C. compared with four last summer.

Oil, in association with gas discoveries north of the Peace, has increased the pressure of gas seeking a market. Regulations prohibit the waste of gas by flaring or for the production of oil. These are the factors behind the growth of Peace River block reserves and behind the plans for a second 30-inch natural gas pipe line to move the gas from the ground in the remote sections of the province to market in the populated sections of the Pacific Coast areas of B.C. and Washington.

A map showing proposed route of the Westcoast Transmission pipe line from the Peace River district to the U.S.-Canadian boundary will be found on page 59 of this issue.

TRANS-CANADA gas line construction delayed

By W. L. Dack

CONSTRUCTION START on Canada's ambitious $350 million Trans-Canada gas pipe line project has been postponed until 1956.

Despite the tremendous efforts of Trans-Canada and government officials to clear away financing problems in time for a spring 1955 start on the 2,350-mile, Alberta-to-Montreal pipe line, negotiations finally broke down.

A last-minute effort is under way to try to salvage at least part of the 1955 program. This would involve a start on the proposed line to Winnipeg in preparation for serving the Minnesota market centering in Minneapolis and St. Paul. This western section would be privately financed and might cause a reduction in line diameter from 34 to 30 inches. Federal Power Commission approval is necessary to this scheme and may not be obtained in time. In the meantime, other western interests have been approaching Dominion officials with an alternate plan.

Disappointment has been very keen in Canada over the one-year setback to the world's longest gas pipe line, particularly since the last minute financing compromise on the part of the Trans-Canada Pipe Lines very nearly succeeded in getting the huge construction job rolling.

Several of the major gas suppliers, Canadian subsidiaries of U.S. oil firms, which had virtually come to terms with Trans-Canada on long-term gas contracts, refused to sign at the last moment. They objected, as a matter of principle, they said, to the final financing shuffle in which the federal government's Industrial Development Bank could end up with control of the pipe line.

Without these suppliers, representing more than one-quarter of the pipe line's gas requirements, it was vain to push financing negotiations any further.

Trans-Canada will now ask both the federal Board of Transport Commissioners and the Alberta Petroleum & Natural Gas Conservation Board for a one-year's extension for its pipe line project. Company officials promise there will be no let-up in contract negotiations both with gas producers and utility companies. With the extra time they are certain they will be able to sign up sufficient gas purchase and sales contracts to enable private financing of the line. In the long-run the delay might prove a blessing in disguise.

It was the difficulty in completing long-term contracts with the western gas producers on one hand and the big utility companies on the other that slowed up the whole program and made normal financing of the "big-inch" line impossible in time for a construction start during 1955.

When contract negotiations bogged down it became obvious that federal government assistance would be needed to get the pipe line over the financing hill in time to firm up pipe orders and assemble all the necessary equipment and worker spreads to complete the first phase of the pipe line job this year—from eastern Alberta to Winnipeg. Thus Trans-Canada asked the government to help clear away financing problems by guaranteeing—for the first two or three difficult load-building years—the interest charges on the $245 million mortgage bonds proposed in connection with the pipe line financing.

After a careful and prolonged study of the whole pipe line proposition by government banking experts, Ottawa refused to guarantee the deal as it stood. One of the chief objections was to the small equity position whereby a relatively small number of Trans-Canada shareholders would control and profit from this multi-million-dollar national project. As a requisite of its assistance, Ottawa demanded that the financing plan be altered in such a way as to spread ownership over a considerably wider group. Trans-Canada is believed to have altered the equity-bond relation from an original 75 percent bonds, 25 percent equity (12½ percent convertible debentures and 12½ common stock) to 70 percent bonds, 30 percent equity. Even then the Industrial Development Bank officials refused to

ESTIMATED TRANS-CANADA GAS SALES
(Exclusive of U.S.)

	Millions of Cubic Feet First Year	Fifth Year
Moosomin to Swift Current, Sask.	4,139	5,381
Portage La Prairie to Brandon, Man.	344	692
Greater Winnipeg, Man.	3,167	9,532
Port Arthur to Keewatin, Ont.	2,805	3,765
Sturgeon Falls to East of Port Arthur, Ont.	17,162	14,881
Brooklin to North Bay	798	2,286
Toronto, Ont.	8,273	24,463
Southern Ontario	7,455	16,817
Morrisburg to Brooklyn, Ont.	4,979	7,207
Ottawa and Hull, Que.	10,718	14,017
Metropolitan Montreal, Que.	31,924	31,334
Ottawa River to Morrisburg	4,249	4,797

Shell Oil Co. rig No. 1 drilling Shell C.P.R. No. 1, one of the early wells in the Jumping Pound gas field, 35 miles west of Calgary. The field has now proved itself a major source of gas to Calgary, Banff and Exshaw, with production from the Madison limestone.

until 1956

guarantee payments on the bonds, but were ready to invest in the covertible debentures.

Although Trans-Canada management is believed to have argued this last offer bitterly, it finally gave in. It was at this point that several of the big Alberta gas producers decided they wanted no part of such a deal. In his announcement of negotiation failure and postponement of construction for another year, Trans-Canada president N. E. Tanner stated:

"The representatives of the company have been unable to negotiate a type of financial assistance which does not result in an agency of the Government of Canada being in a position to control the company, and such an arrangement makes it impossible for the company to purchase its gas requirements."

"We are disappointed, but not discouraged," another Trans-Canada official said informally later. "The line will be built, of that we haven't the slightest doubt. All the government's banking experts as well as those employed by our company, agree that except for the early years of development, the line will be profitable."

As it is, Trans-Canada has two all-important contracts signed up with large gas utility companies, one in Canada, the other in the U.S. Late in February the company finally contracted for enough gas purchase contracts to look after the gas pipe line requirements for the first year of operation.

The first important gas sales contract completed by Trans-Canada calls for export of up to 100 million cubic feet of gas daily to Northern Natural Gas Co., Omaha, Neb., increasing to 150 mcf the second year. This could mean a revenue of $105,750,000 the first year and $163,625,000 the second year. Northern Natural's president John F. Merriam claims 600 unserved communities in his company's market area have asked for gas service. The Canadian gas would help greatly to meet Minnesota's growing gas requirements. Delivery of this gas involves Trans-Canada's building a 24-inch spur line from Winnipeg, Man., to Emerson on the Manitoba-Minnesota border, at which point Northern Natural would link up with a pipe line extension to be built from Minneapolis.

The Federal Power Commission's hearing on Northern Natural Gas's application seeking import approval on the Canadian gas will now be called off in the light of Trans-Canada's failure to arrange financing. The hearing, which started last January, was deferred after a few days to give Trans-Canada time in which to prove that the line could be financed.

The first Canadian utility company signed up to a long-term gas contract is Union Gas Co. of Canada—the largest distributor of natural gas in eastern Canada. The contract calls for 20-year delivery of Alberta gas into the extensive Union system in Southwestern Ontario. Over this period Union contracts to purchase in excess of 300 billion cubic feet of gas from Trans-Canada, delivery to start within the first year after Alberta gas reaches eastern Canada.

This represents a dollar volume in excess of $100 million Union officials state.

An all-important feature of the new contract is this—bulk of the gas will be delivered to Union during the low-demand summer months. Union will be able to feed this gas back into its extensive underground storage system in Lambton County, where it will be available for heavy winter demand.

Union is now importing around five billion cubic feet of gas annually from Panhandle Eastern Pipe Lines under a former contract. As well, Union has negotiated a further gas purchase deal with Panhandle to increase this import figure by a further 15.5 billion cubic feet annually. This now awaits FPC approval. As part of the proposed contract Union will cut off the extra U.S. import supply once Trans-Canada gas is available.

When all necessary government sanctions are received, Union plans a large-scale expansion program to bring natural gas to a much wider area of southwestern Ontario. This will involve construction of a large-inch line from company's Dawn storage field to a point east of Oakville. Laterals will join such cities as Hamilton, Guelph, Kitchener-Waterloo, Stratford, and St. Mary's.

Although no other sales contracts have so far been concluded, Trans-Canada is negotiating with all the present large gas utility companies that come within scope of the pipe line. This includes Saskatchewan Power Corp., Winnipeg & Central Gas, Consumers' Gas Co. of Toronto, Interprovincial Gas (Ottawa), Dominion Natural Gas (Brantford, Ont.), and Provincial Gas (Fort Erie, Ont.). Preliminary discussions have also been held with several newly-formed gas distribution companies which are presently seeking to obtain gas franchises in a number of Ontario municipalities.

Although trying to work as closely as possible to a standard contract form, Trans-Canada has had to adapt contract features to particular municipalities with special problems. Failure to arrive at an agreeable contract with The Consumers' Gas Co. of Toronto, for instance, has had to do with the interrelation between

quantity and price on firm and interruptable industrial gas.

But there is no question that any of these utility companies will not ultimately sign. They all want natural gas and considerable progress has already been made in working out mutually agreeable contracts.

Most disappointing market of all has been Montreal—the largest potential gas market in Canada. The present manufactured gas service is being supplied by an agency of the Quebec government. So far little enthusiasm has been shown by provincial authorities outside of launching an extensive market survey. Pipe line officials have little doubt, however, but that Montreal will eventually want gas.

Trans-Canada has also carried on extensive sales talks with large industrial customers that so far are not in any active franchise area.

After several months of fruitless contract negotiations with Alberta gas producers, an agreement was completed with a group of producers in the Cessford field in February. This calls for purchase of more than 125 mmcf of gas daily. This is approximately one quarter of the capacity of the proposed Trans-Canada pipe line and sufficient to look after the first year's market requirements. Field starting price is 10 cents per mcf, and if the trunk gathering line costs are lower than estimates, producers will profit by the difference. An escalator clause is slated to raise the 10 cents by a quarter of a cent a year over a 20-year period.

It is doubtful if any major gas pipe line project has had to face the diversity of obstacles that have been thrown in Trans-Canada's path.

With the bulk of the gas market on the remote end of the pipe line, the big problem has always been to sell gas cheaply enough on that end to be able to compete with other fuels and still be in a position to pay producers an attractive enough price for their gas on the other end.

Compliance with federal aims and regulations on one side and provincial on the other, often at cross-purposes, has complicated planning right from the start. The Alberta government, for instance, has always favored a substantial sale of its gas into the mid-northern U.S. with sales to eastern Canada at a later date when that market had been built up with imported U.S. gas. But the federal government's idea, strongly championed by Trade Minister C. D. Howe, has been just the opposite. Mr. Howe has insisted that the Trans-Canada line follow an all-Canadian route to eastern Canada and that it be completely financed on that understanding: that it be on its way to eastern Canada before any federal government approval would be forthcoming for gas export into U.S.

The Alberta government and gas authorities have maintained that the southern route to Ontario and Quebec (south of the Great Lakes and paralleling the recent Interprovincial oil pipe line which travels a good part of its way through the U.S. before dipping back again into Canada at Sarnia, Ont.) is the more economical one. Since the federal government blocked such a plan it should be prepared to compensate the gas producers through a subsidy, or some form of pipe line aid, that would permit Trans-Canada to offer a more attractive field price, they claim.

With the pipe line start now postponed for another year, there will be strong pressure again brought to bear in an effort to alter Ottawa's firm stand.

Extensive surveys into the economic feasibility of a Trans-Canada gas pipe line have all agreed on one point. Only by making use of the transportation economies of moving a large quantity of gas through a "big-inch" pipe line can western gas be laid down at eastern points competitive with other fuels.

Because the climate will ultimately lead to very heavy loads in winter for heating purposes, full economical use will have to be made of available off-season storage facilities and interruptible industrial markets.

In the Trans-Canada project the line will be of 34-inch diameter from eastern Alberta to Winnipeg and 30-inch from there the rest of the way to Toronto. At 100 percent load-factor, this line could move over 540 mmcf daily and gas could be priced at around 46 cents per mcf.

The lateral line from Toronto to Montreal would be of 24-inch diameter, as would also the lateral from Winnipeg to Emerson.

The substantial gas storage fields in southwestern Ontario owned by Imperial Oil and Union Gas Co. of Canada will be closely integrated into the over-all Trans-Canada system.

A strong management team has been built up to help carry out the vast Trans-Canada propect. N. E. Tanner, oilman and former Alberta Minister of Lands & Forests, heads up the Trans-Canada company. Charles S. Coates, former senior vice president of Tennessee Gas Transmission Co., is vice president and general manager.

Bechtel-Mannix-Hester — a newly created pipe line firm — will supervise engineering, design and construction of the pipe line. This firm represents a merger of some of the best pipe line engineering brains on the continent—Canadian Bechtel Ltd., Toronto; Mannix Ltd., Calgary; and Oklahoma Contractors, Oklahoma.

The line will encounter relatively little terrain difficulty until it strikes the rugged Canadian shield country north of Lake Superior. A recent route alteration shifts the course from one paralleling the CPR line skirting Lake Superior to one further north running parallel to highway No. 11. This more northerly route—although some 100 miles longer — will take the line close to some of the major northern Ontario pulp and paper mills and mining camps.

Pipe line steel tonnage is estimated to run around 625,000 tons and will all be imported, since no Canadian pipe-making facilities can roll such large diameter pipe. In the course of its route, the line will cross railways some 86 times. There will be 110 major river crossings and 240 crossings of creeks and streams.

In the meantime another important arm of the over-all Trans-Canada pipe line system has been completed and is now operating—the 80-mile, 20-inch line from a Niagara River crossing point to Toronto. Trans-Canada built this line this summer, and has leased it to Consumers' Gas Co. of Toronto until prairie gas reaches eastern Canada when the U.S. imports will be cut off. First flow of U.S. gas from Tennessee Gas Transmission Co. into this new pipe line began in November and now the entire Toronto metropolitan area has been converted from manufactured to natural gas. Since it will take two construction years to complete the pipe line from Alberta to Toronto and a start will not be able to be made now until spring 1956, there will be a two-and-a-half-year build-up period on imported U.S. gas in the Toronto area.

Trans-Canada officials are seriously considering extending this Niagara-Toronto line eastward, possibly as far as Montreal—if satisfactory marketing and financing arrangements can be made. Such a move could greatly speed up the growing picture in the big concentrated Ontario and Quebec markets.

Energy requirements in this country by 1975—on the basis of Canada's population growing to 22.5 million by that time (now 15.5 million)—have been estimated by a top government economist at around 5.5 trillion cubic feet annually, or some 100 percent above last year.

There has been a wide variation in the forecasts of how much of this rapidly growing energy market natural gas will be able to take over. But the same government expert forecasts that natural gas will be able to at least double its present share, to around nine percent.

Another natural gas marketing study prepared by the Stanford Research Institute and the University of Western Ontario puts natural gas' share of the energy market very much higher — around 30 percent by 1975. This study was based largely on gas' meteoric rise in U.S.

Those two viewpoints represent a 1975 annual gas market in Canada ranging between 0.4 trillion and 1.2 trillion cubic feet. Trans-Canada officials have estimated a minimum marketing expansion in the first 10 years of pipe line operation of at least 500 percent, which would represent a sale in Canada by 1966 of at least one billion cubic feet of gas daily from the Trans-Canada pipe line system.

Floyd Kellogg Beach retired five years ago after many years of engineering service to the Dominion and Alberta Governments. Since then he has been busier than before retirement as a consulting engineer at Calgary specializing in reservoir and other petroleum production problems and as western field editor of Canadian Oil and Gas Industries. He has been a previous contributor to WORLD PETROLEUM *on natural gas problems in Western Canada.*

Natural gas in Western Canada

By Floyd K. Beach*

ALBERTA has a lot of natural gas—more than can be hoped to be used commercially in the provinces within the life of the youngest living Albertan. Eastern Canada, with the principal industrial development of the country, now has to depend for its energy requirements on imported fuels plus domestic hydroelectric power, and the cost of imported fuel is a heavy charge on the economy of the country. Trans-Canada Pipe Lines proposes to carry the surplus Alberta gas to industrial eastern Canada in a project that is admittedly of Herculean proportions, but which should be economically feasible, and which when achieved would repay the owners of gas properties for their ventures and at the same time eliminate the continued bleeding of Canadian funds for the purchase of fuels outside the country.

Why, then, is Trans-Canada not actually ready to lay its pipe from Alberta gas wells to Ontario homes and factories? Consider first what has been done, then what is needed.

Progress Made: The people of Alberta and their government have been shown that removal of gas would not deprive Albertans of gas for themselves. The Alberta Conservation Board in March 1954 found 4.35 trillion cubic feet available for Trans-Canada after providing for all conceivable demands within the province for 20 years, and for other commitments for Montana and for westward export.

The Dominion of Canada agreed to the project, including permission for Trans-Canada to deliver gas to Northern Natural Gas Co. for use in the Minneapolis area.

Trans-Canada has reached agreement with Northern Natural as to price delivered at the U.S. border, and with Union Gas (distributors in a part of Ontario) as to price delivered at a suitable Ontario point.

Trans-Canada has built a connection to take U.S. gas at the Niagara River and has piped it to Toronto, so as to build up consumer connections prior to building the main transmission line from Alberta.

Alberta Gas Trunk Line, formed as a separate and distinct corporate entity from Trans-Canada, in accordance with the wishes of the Alberta government to gather gas and deliver it to the Saskatchewan border, has been formally organized and has made preliminary surveys and plans. It will presumably be allowed a utility rate on its investment. It has Alberta authority to build the first stage of its main line, and a number of gathering lines.

Contracts for the purchase of enough gas to supply the first phase of the scheme have been made by Trans-Canada. This includes delivery of gas as far as Winnipeg and to a connection with Northern Natural Gas at the border south of Winnipeg.

Other contracts are almost ready to sign. There has been uncertainty on the part of many owners of gas properties as to what it will cost them to do the physical work of gathering their gas and preparing it for market — uncertainties that require design and estimation of cost, and which take time to complete.

Progress Needed: Formal approval by the Federal Power Commission is needed before Northern Natural can take gas from Trans-Canada, or even start to lay the necessary pipe lines. This approval cannot be expected until Trans-Canada has shown that it has gas to deliver and funds for building the line.

Financial arrangements for the project still need consummation, and it is certain that those who supply the money will need to be shown that there is a sufficient market at a satisfactorily high price under contract by eastern gas distributors, and a sufficient supply of western gas

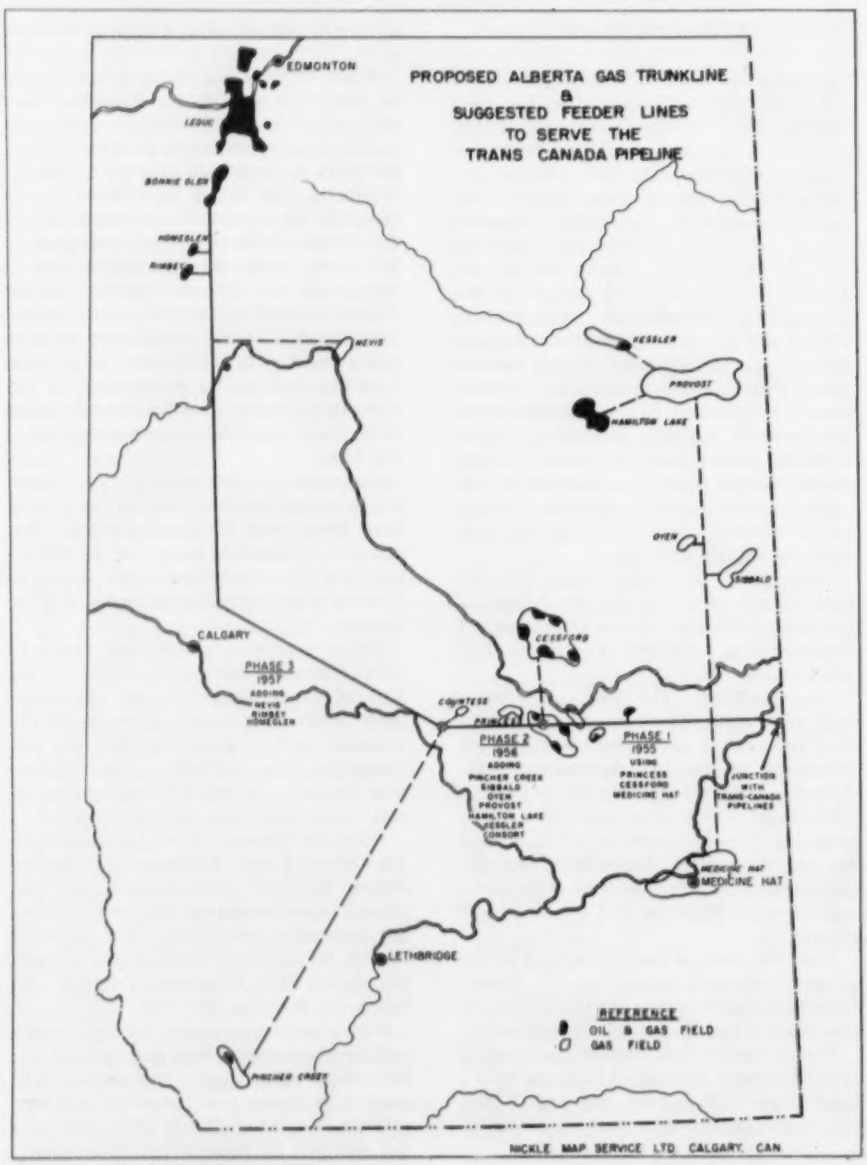
* *Consulting Engineer, Calgary.*

producers at a satisfactorily low price also under contract to permit the project to become self-liquidating.

Trans-Canada has announced that its contract with Union Gas (distributors in part of Ontario) is for 300 billion cubic feet over a 20-year period for around $100 million. This is in the neighborhood of 35 cents per mcf.

Trans-Canada has been offering producers 10 cents/mcf. initially, with an escalator clause increasing ¼ cent annually for 20 years. Since the early years will probably have a lighter load than the later years, let us say the average will be 13 cents. This price is at the field gate, and Trans-Canada must pay Trunk Line for moving the gas to the Saskatchewan border. Laterals from field gate to main line will vary in cost, some being short, some long. Cost of moving gas from field gate to the Saskatchewan border may be as low as 4 cents. If lower than that, the producer will get the benefit. Just to be on the safe size, let us take 6 cents in figuring. This would mean that the cost to Trans-Canada at the Saskatchewan border will be 19 cents.

If we suppose that the contract with Union Gas is a yardstick for Ontario price, this leaves 16 cents to Trans-Canada. Some gas will go to Saskatchewan and Manitoba cities, and quite a chunk will go to Northern Natural. The gas to Northern Natural will have a lower price than to Ontario. That contract is involved with load factor. We would guess that a quarter of total handlings through Trans-Canada will yield 28 cents, bringing Trans-Canada yield to around 33 cents and leaving 14 cents to pay cost of construction, interest and operation.



Map courtesy Canadian Oil Journal, Edmonton.

Assuming 4.35 trillion cubic feet as the total 20-year throughput, a little arithmetic suggests revenue in the neighborhood of $600 million. Assume that the first five years from the time money is borrowed will be taken up with construction and building up load. Add compound interest at five percent to the initial cost of $300 million, and there will be $400 million to pay off. If in the sixth year Trans-Canada can start retiring 10 percent of its indebtedness annually, thus reducing the interest charges, there remains some $200 million to meet operating charges, interest on the remaining bonds, and profit. We cannot suggest what operating costs will be, and suggest five percent of the initial cost, or $15 million, and we suggest that things would need to go very badly in building up load if the venture is to fail to liquidate itself.

Of course there is the circumstance that the government of Canada has insisted on an expensive route, all Canadian, from west to east. It would be less costly to parallel the Interprovincial pipe line, where the pipe will be laid in sediments, than to cross the pre-Cambrian shield where rock outcrop alternates with lakes. Actually, Trans-Canada now considers a route through a clay belt along the C.N.R. It will be somewhat longer, but will probably avoid many obstacles. When government dictates a costly route, should it not assume some financial responsibilities? Trans-Canada for a long time avoided asking any help from the government, but when stymied in its application to the Federal Power Commission by need of a guarantee of bonds, it rather reluctantly asked for a government guarantee. As is usual when government is asked to do something, no immediate reply was forthcoming, even though government had set a deadline for financing. The deadline is likely to be extended, and with an encouraging start in completing gas purchase contracts, we suggest that financing might become possible without government help.

Considering the impact on any undertaking of interest during construction and early stages of market building, we suggest that even the more costly all-Canadian route might in the end be cheaper than a route which involved the delays inherent in involving main line construction approval in decisions of a commission outside Canada. Delay in decision of the FPC seems a foregone conclusion when a project is subject to intervenors.

C. W. Murchison originated the Trans-Canada idea and carried the load of gas appraisal and promotion for several years, an appraisal made in great detail by DeGolyer and MacNaughton, giving reports on construction costs, on markets, future gas demand within Alberta, legal expense, organization costs, not to mention an energetic exploration program by his

company, Canadian Delhi. Early in 1954, Trans-Canada combined with H. R. Milner's Western Pipe Lines on a 50-50 basis. The new company then secured as president N. E. Tanner, for many years Alberta Government Minister of Mines and Minerals and Lands and Forests, to do the soft talking needed to get the child to go to bed.

Mr. Tanner has gathered around him some top-notch talent: C. S. Coates, a veteran pipe liner who resigned as senior vice president of Tennessee Gas Transmission Co. to take the job of executive vice president of Trans-Canada; A. P. Craig to become vice president in charge of sales; D. R. Pflug as chief engineer; and Don Wallace to negotiate contracts with producers. Many others who are well qualified in their respective lines have been added to the staff and there appears to be every hope that the project will be a powerful means of building Canadian economy. The dates of each phase of the undertaking may be somewhat later than at first forecast, but not seriously late.

Aside from Trans-Canada there are a number of other markets open for part of the gas production in Western Canada. These include exports to Montana, increased local use for fuel and petrochemicals in Alberta and exports to the Pacific Northwest.

Canadian Montana Pipeline Co. has a line from Pakowki Lake extending to the copper smelter in Great Falls and with other distributing lines. In a 1954 report of the Alberta Petroleum and Natural Gas Conservation Board, 386 billion cubic feet were allocated from the fields near Pakowki Lake to this export, subject to government approval. It is interesting to note that a branch from this line re-enters Canada to serve two towns close to the Montana border.

Ammonia from natural gas has been made since the years of the second war in a plant near Calgary. Plants at Edmonton use natural gas as the start of chemicals used in making rayon and polyethylene. Calgary Power Co. has drawings on the boards for a plant on Lake Wabamun, some 40 miles west of Edmonton, to generate power from gas and to use some five billion cubic feet annually. At Vermilion, power is being generated by Canadian Utilities in a gas turbine fired by natural gas. Currently announcements have been made of an ammonia plant to be built at Medicine Hat to use natural gas from Etzikom wells of New British Dominion Oil Co.

Westcoast Transmission Co., with gas fields in the Peace River area of British Columbia and Alberta, has for some years been working toward a pipe line to serve Vancouver, B.C. and neighboring communities, the cities of Seattle, Washington and Portland, Oregon, and population tributary to those cities.

In June 1954, the Federal Power Commission refused their application to bring gas to the United States, and approved an application of Pacific Northwest to supply that part of the country as well as cities along the route from gas fields in the San Juan basin. (See WORLD PETROLEUM, December 1954.)

Dismantling of Shell's rig No. 1 following completion of drilling operations at Shell Jumping Pound Unit 12. The Jumping Pound gas field is located about 35 miles west of Calgary.

Subsequent agreement between Westcoast, Pacific Northwest and El Paso Natural Gas Co. appears to clear the way for Westcoast to turn over natural gas at the international boundary near Vancouver to the combined system. It is expected that approval of the scheme will be required by the Federal Power Commission, but Westcoast feels that this approval is likely to be only a formality, since no intervenors are expected.

Westcoast's route passes from the gas fields through Pine Pass, parallel to the all-weather John Hart and Cariboo highways to the vicinity of Huntingdon, B.C. (See map).

The project comprises 650 miles of 30-inch pipe with ⅜-inch wall thickness main line, 223 miles of gathering lines and 47,000 horsepower in compressor stations.

Initial capacity will be 370,000 mcf. daily to deliver 300,000 mcf. daily to U.S. and 70,000 mcf. to markets in Canada. Cost for this capacity will be $142 million, including working capital.

Gas reserves for Westcoast were estimated early in 1954 as 600 billion cubic feet in Alberta, and evidence given by W. C. Spooner before the FPC showed reserves in British Columbia of 1,912 billion cubic feet in place, or about 1,666 billion cubic feet pipe line gas. Since those appraisals were made, an active exploration program has continued to add to reserves.

A gas line from Smiley, Coleville and Brock fields extends some 130 miles to Saskatoon, Sask., and handled about three billion cubic feet in 1954. Some minor gas production presumed to be associated and dissolved gas comes from numerous oil fields and is available for field operation and lifting oil. The town of Lloydminster and the town of Unity are served from short pipe lines and the total production for 1954 from all sources was of the order of five billion cubic feet.

The Saskatchewan Power Commission, a corporation owned by the provincial government, operates the line to Saskatoon, buying gas in the various fields, transmitting and retailing, and the present prospect is that SPC will continue its policy of socialized management of natural resources in respect of gas. Some reserves have been built up in Hatton field, an eastward extension of the Medicine Hat field of Alberta, close to the projected location of the Trans-Canada main line, and it would not be surprising if SPC gathered this gas, compressed it and put it into the Trans-Canada line for transmission to Regina and other Saskatchewan cities so as to get credit for bringing Saskatchewan gas to Saskatchewan consumers.

After building the gas line to Saskatoon, oil was found in the same Viking sand that contains gas in the Coleville-Eureka-Smiley area. Operators of oil wells producing from this sand became somewhat unhappy about allowing depletion of gas until oil is depleted. After some negotiation it was agreed that withdrawals of 30 million cf/day and not to exceed five billion cubic feet annually could be taken for a time until effect of this withdrawal could be observed. This would aid in amortizing the pipe line built in expectation of getting the gas.

Saskatchewan reserves have not received the same thorough appraisal as those in Alberta, but there are indications from various sources that the reserves are of the order of 750 billion cubic feet, not including gas dissolved in oil. It is of interest to note that small gas supplies have been drawn for some years from shallow wells of 300 or 400 foot depth near Kamsack, near the Manitoba boundary. The gas is insignificant in total reserves, but rather useful to farmers for heating their homes.

Manitoba has no known gas save small amounts dissolved in oil.

Royalite Oil Co. producing wells in the Coleville, Saskatchewan field where great care must be taken to protect growing crops.

Saskatchewan

By R. Pot

LONG OVERLY-DEPENDENT on a strictly agricultural economy, Saskatchewan has made notable strides in the past five years in oil and gas development.

Since 1949, almost $200 million has been spent solely on exploration and development in Saskatchewan. In return, about 18 major companies, working closely with about 12 good sized independents and only a handful of smaller operators, have proven up oil reserves estimated at 243 million barrels. Indicated proven, proven, probable and possible gas reserves in presently discovered fields are estimated at one trillion cubic feet.

Saskatchewan stands today unrivalled as Canada's second oil province.

Crude oil production in Saskatchewan during 1954 totalled 5,255,614 barrels. This about doubled the 1953 production figure of 2,797,888 barrels. The most recent production figure appears all the more impressive when one considers that it is more than one third of the total of all the crude ever produced from Saskatchewan wells. Since 1945 (the first year in which that province shows any production) to the end of 1954, output of crude has totalled just over 14 million barrels.

As mentioned earlier, about $200 million has been spent by a relatively few number of operators in this very large territory since 1949 solely in an attempt to prove up new oil and gas reserves. Of this, some $10 million was spent in 1950, $20 million in 1951, $50 million in 1952 and almost $60 million in 1953. Continuous and rapidly mounting expenditures were held in close check during 1954, with the result that for the second successive year, exploration and development expenses totalled about $60 million. Some companies can now see hope of regaining at least part of their earlier capital outlays with the rapidly growing production.

New wells drilled and completed totalled 784 during 1954, an increase of 110 wells as compared with the previous year. The average depth of each well drilled in

1954

Robert Pot has been a partner in the consulting firm of Trafford & Associates, Calgary, since 1951 when he resigned as chief petroleum reservoir engineer for Imperial Oil Ltd. Prior to World War II he served as a petroleum engineer in Venezuela for the Shell Group and at the close of the war he aided Shell in the rehabilitation of its oil field installations in Borneo. He joined Imperial in 1947 when the Canadian boom was beginning.

1954 was 3,245 feet, slightly less than 1953's 3,426 feet.

As compared with 1953, the ratio of successful wells completed to wells drilled was maintained during 1954, possibly a direct result of keeping exploration and development expenditures in line with those of the year earlier. There were 305 oil wells and 21 gas wells completed, increasing to 1,097 the number of oil wells capable of production and bringing gas wells in that same category up to 119.

The year 1953 saw 674 wells drilled and completed, of which 276 were oil wells capable of production and 17 were gas wells. Successful oil and gas wells represented 41.5 percent of the total drilled in 1954 and 43.5 percent in 1953. It is interesting to note here, too, that newly proved reserve in each of the years 1953 and 1954 was consistent at 60 million barrels of crude oil.

Saskatchewan wildcats in 1954 totalled 345 wells for a total footage drilled of 1,279,787 feet, an average of 3,710 feet per well. One in every 12.25 wildcats drilled was either a successful oil or gas well, resulting in a combined total of 28 discoveries. Of the 28, seven were natural gas wells and 21 were oil wells, all capable of commercial production.

Activity was once again almost entirely restricted to the southern part of the province. Drilling rigs were especially active in the Swift Current area during the latter part of 1953 and early 1954, resulting in five of Saskatchewan's oil discoveries and one gas discovery well in this region. There was, however, a noticeable swing of activity into southeastern Saskatchewan around mid-year.

It was in this general medium gravity crude area that the province's most numerous and possibly most significant finds were made. A total of 13 oil discoveries were recorded and there are indications that a new field may be shaping up as a result of two of these. Of interest too were the three Viking Sandstone light gravity oil finds in the Coleville and Hoosier areas of west-central Saskatchewan. The Viking sand gas cap in this same locale gave up six of the province's gas discoveries during 1954. The only other gasser, completed late in the year, was drilled in the general Swift Current area, about 10 miles west of Gull Lake and flowed gas from the Upper Shaunavon in the Jurassic sands.

Imperial Oil Ltd. came up with four oil strikes and one gas find during the year under review. A Viking gas well completed June 4 was the company's first commercial discovery. Imperial-Coleville 7-1-32-23, LSD 7-1-32-23 W3 (reference 1 on map), flowed gas at the rate of 1,300 mcf per day from interval 2,228-2,240 feet. Close by and immediately following this success, Imperial found 31° gravity oil 2½ miles north of the Coleville field. The well, Imperial-Eureka 6-35, Lsd 6-35-31-23 W3 (reference 2), is producing about 37 barrels of oil per day from a depth of 2,405 feet in the Viking.

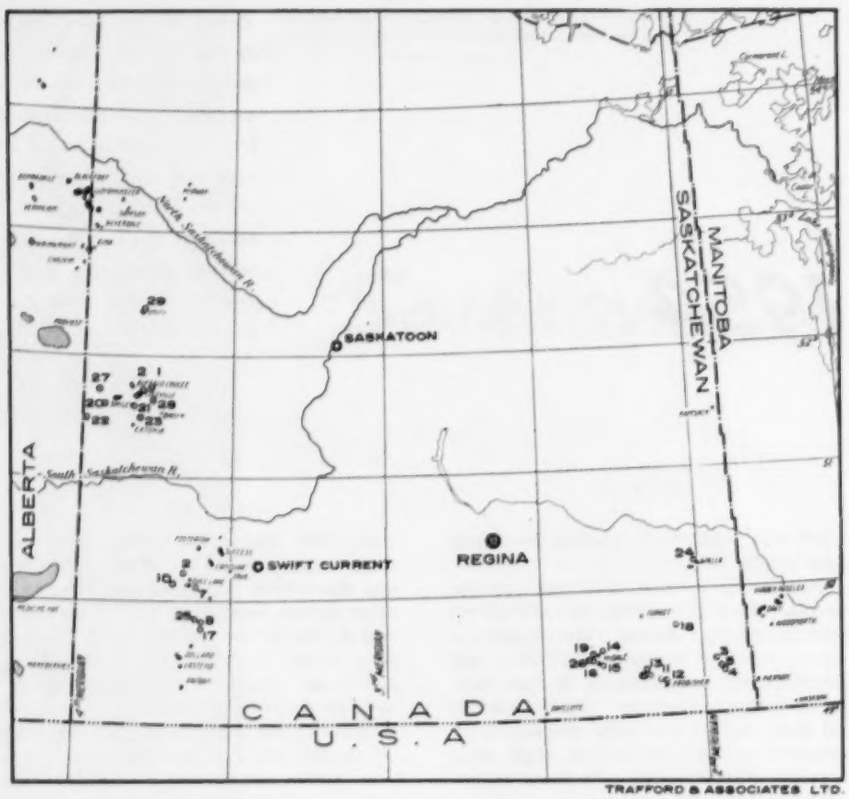
In southeast Saskatchewan, Imperial-Alida 4-35, Lsd 4-34-5-33 W1 (reference 3), Mission Canyon oil discovery completed late in the year, was within 30 days followed by another Mission Canyon find, Imperial-Nottingham 9-26-4-32, Lsd 9-26-4-32 W1, (reference 4), about 9 miles southeast of the Alida well. Imperial-Alida 4-35 has a rated I.P. of 180 barrels of 38° gravity oil per day from perforated interval 3,668-3,680 feet. The Nottingham well is producing 34° oil from a 14 foot perforated interval 3,510-3,530 feet with maximum pipe recovery of 600 feet of oil during drill stem tests. At year's end there was one Mission Canyon oil producer in the Alida pool and one in the Nottingham pool. A Socony-Woodley-Southern well, Socony-Woodley-Southern-Alida 10-10, Lsd 10-10-5-32 W1 (reference), was completed just after the turn of the year and is producing from the same formation about midway between these two. These separate pools may develop into a sizable light gravity crude field. Imperial-Browning 1-8, Lsd 1-8-4-5-W2 (reference 6) was that company's fourth discovery oil well for the year. The find, made in December at a point 8 miles northwest of the Frobisher field, is producing 34° oil from the Charles member of the Mississippian.

Socony-Vacuum Oil Co. of Canada Ltd., the most active of any of the companies operating in Saskatchewan during the year, came up with three medium gravity oil finds and one gas strike. (Socony-Woodley-Southern-East Gull Lake 28-11, Lsd 11-28-13-18 W3 (reference 7), located about 50 miles southwest of Swift Current, came on production September 2. The well has a rated initial potential of 40 barrels of 22° gravity oil per day from the Cantuar sands. Closely following and in the same general area, Socony-Woodley-Southern-South Illerbrun 21-8, Lsd 8-21-10-18 W3 (reference 8), and Socony-Woodley-Southern S.E. Midway 20-5, Lsd 5-20-14-19 W3 (reference 9), were successfully completed as that group's final two commercial oil discoveries. During a one hour drillstem test in the J-2B of the Jurassic or lower Shaunavon, interval 4,485-4,564 feet, the Illerbrun 21-8 well recovered 2,240 feet of oil and 1,124 feet of water. The Midway 20-5 well is producing 12 barrels of medium gravity oil per day from the J-2A of the Jurassic, or upper Shaunavon. Discovery zone in the Socony group's single gas discovery was once again the upper Shaunavon. The well, Socony-Woodley-Southern-Tompkins 30-14, Lsd 14-30-13-20 W3 (reference 10), is located about ten miles west of Gull Lake. During drillstem test of interval 3,745-3,757 feet, gas flowed at a maximum rate of 7,000 mcf per day.

Concentrating its efforts in the southeast corner of Saskatchewan, Canadian Gulf Oil Co. discovered three medium gravity oil wells. One of these, Quinn 9, Lsd 9-34-3-4 W2 (reference 11), about 23 miles northeast of the town of Estevan, brought in production March 28, is considered by many oil men to be one of Saskatchewan's most important discoveries to date on the basis of drillstem tests. The first two drillstem tests gave up gas at a rate of 6.5 mmcf per day and 10 mmcf

REFERENCE LEGEND

1 COLEVILLE
2 EUREKA
3 ALIDA
4 NOTTINGHAM
5 ALIDA
6 BROWNING
7 E. GULL LAKE
8 S. ILLERBRUN
9 S. E. MIDWAY
10 TOMPKINS
11 QUINN
12 MOFFATT
13 WALTER
14 HUNTOON
15 VIEWFIELD
16 HOLLOWAY
17 INSTOW
18 WHITE BEAR
19 GILL
20 DEWAR
21 ST. FLORENCE
22 EASTSIDE
23 VERENDRYE
24 N. WAPELLA
25 BONE CREEK
26 W. MIDALE
27 HOOSIER
28 HOPEDALE
29 UNITY



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Roland Thompson, Royalite Oil Co. production manager, officially opens the Mid-Saskatchewan Pipe Line by turning a gathering line valve at Smiley, Sask.

per day, respectively. The third test, of interval 4,645-4,655 feet, brought gas to surface in three minutes and oil in eight minutes to flow for 65 minutes to the pits and then for 30 minutes through a separator to fill a 55 barrel test tank. A fourth test of cored interval 4,655-4,660 feet reached the oil-water contact and established about 24 feet of pay. Oil flowed for 11 hours before salt water was recovered on this final test.

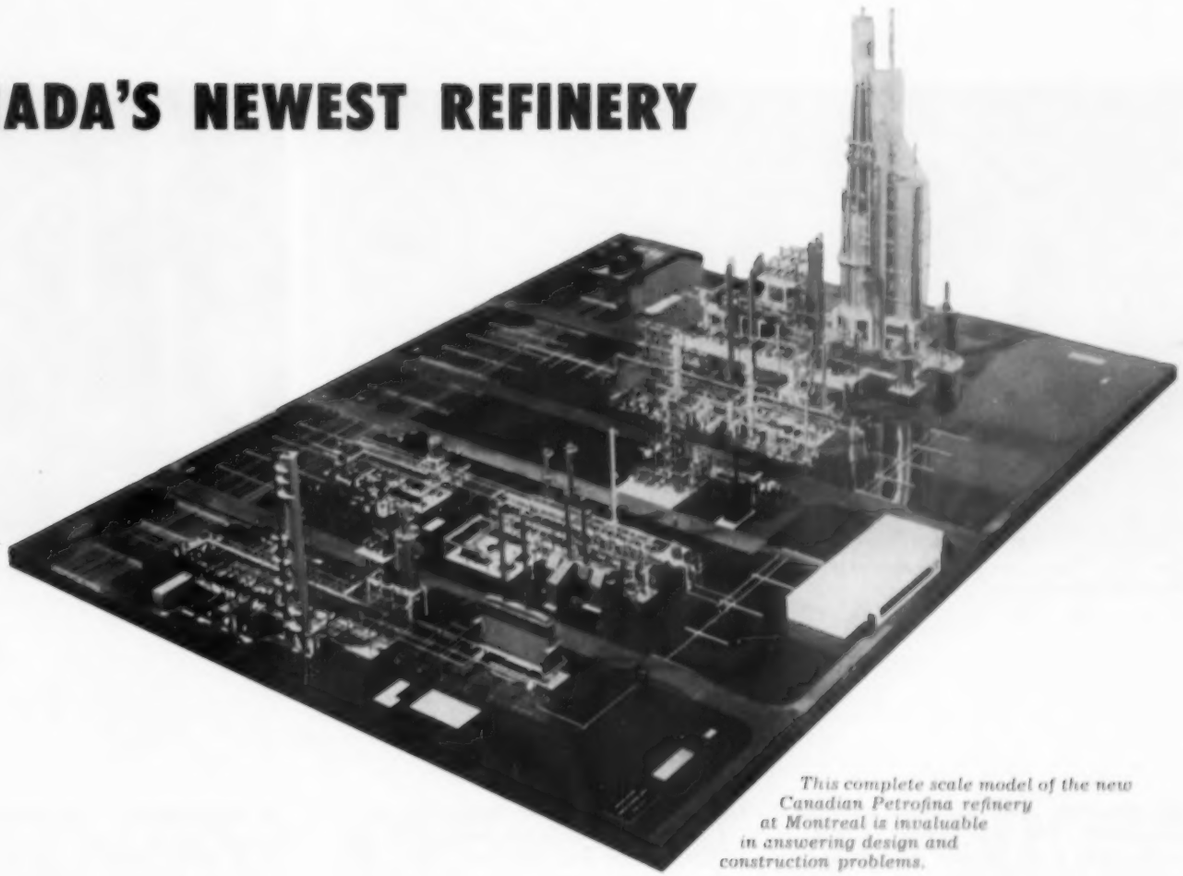
Gulf's Moffatt 11 well, Lsd 11-35-3-4 W2 (reference 12), about three miles north of Frobisher rail point, was put on production June 1. This find rated an initial potential of 595 barrels of 40.5° gravity oil and 528 mcf of gas per day through a 20/64 inch choke during a 10-hour test. The Moffatt 11 well is producing from the Mission Canyon zone at a depth of 4,654-4,660 feet. Gulf completed its third find of the year, a medium gravity oil well, on December 17, 1954. Walter 5, Lsd 5-14-5-6 W2 (reference 13), 20 miles northeast of Estevan, rated an initial potential of 78 barrels of 36° gravity oil per day from the Charles at a depth of 4,520 feet. The Mission Canyon, some 100 feet higher, tested also water-free oil.

Shell Oil Co. chalked up three medium gravity oil finds, all in the southeast sector of Saskatchewan and in the general area of the Midale oil field. Shell-Huntoon A-8-12, Lsd 8-12-7-10 W2 (reference 14), was completed September 15 and rated an initial potential of 11 barrels of 28° oil per day from the Mississippian at a depth of about 4,400 feet. Two weeks later, Shell Viewfield A-5-12, Lsd 5-12-6-10 W2 (reference 15), was completed as a Mission Canyon oil well. Toward the end of October, Shell-Holloway A-10-20, Lsd 10-20-6-11 W2 (reference 16), rated an initial potential of 69 barrels of oil and 20 barrels of water in 13 hours while on pump. The well is producing from the Charles formation at a depth of about 4,560 feet.

Tidewater Associated Oil Co., in association with Ohio Oil Co., Atlantic Refining Co. and Columbia Carbon Co., accounted for two oil discoveries during 1954. The first of these, T.W.-Instow-Crown 1-34, Lsd 1-34-9-18 W3 (reference 17), was a medium gravity find about nine miles north of Shaunavon rail point and is producing from the Upper Shaunavon sands of the Jurassic. In the southeast sector of the province, T.W.-Ajax-White Bear 4, Lsd 9-12-9-3 W2 (reference 18), was brought into production on December 19, 1954 as a light oil (32° API) discovery. Tidewater holdings, originally covering approximately nine million acres of Saskatchewan government lands, since reduced to about seven million acres, enable

(Continued on page 166)

CANADA'S NEWEST REFINERY



This complete scale model of the new Canadian Petrofina refinery at Montreal is invaluable in answering design and construction problems.

By P. de Haulleville

Baron P. de Haulleville graduated from Brussels University after having worked in power plants, ferro-alloy metallurgy and the chemical industry, specializing in economic studies. In 1949 he entered the refining branch of the oil industry as engineer with the Compagnie Financière Belge de Pétroles (Petrofina S.A.), Brussels. After a training period in the Middle East, he was appointed process superintendent in 1951 of the S.I.B.P. refinery in Antwerp, jointly owned by the Anglo-Iranian Oil Co. (now B.P.) and Petrofina, before being sent to Canada where he is involved in the Canadian Petrofina refinery construction project.

Maximum integration of processes with centralized control to reduce manpower requirements features new Canadian Petrofina refinery under construction at Montreal.

THE PRIMARY OBJECTIVE in refining crude oil is the realization of the maximum potentialities of the crude or, in other words, the production of the greatest possible quantity of commercially valuable products and the reduction of the proportion of commercially less attractive products to the absolute minimum.

The methods employed to achieve these ends necessarily vary widely from one refinery to another, depending on the type of processes used, the nature of the local market, and so on, but all refinery methods are ultimately dependent upon four basic operations which will be briefly considered.

The first process is fractionation. By this means the complicated mixture of products comprising crude oil, or other petroleum mixtures, is broken down into simpler products or "cuts"; each cut being characterized by a carefully controlled boiling range. Fractionation is thus essentially a physical operation, the purpose of which is to classify, or, in other words, to sift. However, certain of these cuts do not have a high commercial value.

The second basic type of operation, essentially chemical this time, consists in transforming those cuts which have a low commercial value into more acceptable products. There are many ways of doing this, but all consist fundamentally in altering the molecular structure of the product. In the case of a heavy oil, the molecules may be cracked to form lighter

View of the bulk plant loading rack at the Montreal refinery site.

The HCC unit under construction.

and therefore more valuable products concurrently with still heavier residues. On the other hand, gaseous products may be alkylated or polymerized to form liquid products which may be blended into gasoline.

With certain processes, catalytic reforming for instance, both cracking and polymerization reactions take place concurrently with hydrogenation, dehydrogenation and isomerization.

The net result of all those transformations is the production of mixtures containing new arrays of hydrocarbons which have a higher commercial value than the starting materials. These mixtures, submitted to fractionation, yield a further series of cuts.

Nearly all the cuts produced by the processes described above contain certain objectionable impurities, of which sulfur is the commonest and also the most troublesome. The third basic operation, therefore, is called purification; it consists of the removal of those impurities. Widely diversified means are employed, depending mainly on the nature of the crude oil being processed.

The fourth and last basic process is the blending of the purified cuts into commercially acceptable products such as motor gasoline, stove oil, diesel oil, and furnace fuel oil, according to their characteristics.

Those four fundamental processes comprise the basic operations of the refinery and every other activity in the refinery is subsidiary to them.

Now that we have mentioned the only rule of the game—increasing the value of petroleum crude—and the four operations to which its pawns (the hydrocarbon molecules) submit, let us see how Canadian Petrofina has decided to play.

Canadian Petrofina has been operating in Canada for less than two years, but it has, nevertheless, achieved an established position in the marketing field.

It is estimated that the initial throughput of its refinery will be of the order of 20,000 barrels per day.

The main preoccupation of Canadian Petrofina is with the manufacture of petroleum products which will exceed in quality the best now offered on the Canadian market or which are likely to be offered in the foreseeable future. To this end every effort has been made to provide sufficient flexibility in the operations of the refinery to anticipate future requirements. For example, it is well known that the available crude oil reserves show an upward trend in density as well as in sulfur* content and this has been borne in mind in designing of the refinery.

I. *Crude fractionation* will take place in a conventional combined topping and vacuum distillation unit. The cuts, of which none will be commercially usable as such, are as follows:

1. Light non-condensable gas: This will be utilized in the refinery fuel system after H_2S and C_3's are removed.

2. Light gasoline: This will be blended after caustic washing and sweetening.

3. Heavy gasoline: This product constitutes part of the charge to the reformer.

4. Stove oil: After desulfurization, this represents a finished product.

5. Light gas oil: Part of this stream will go to the desulfurization unit and the balance to the catalytic cracker.

6. Heavy gas oil: This constitutes part of the charge for the catalytic cracker.

7. Bottoms: Initially this product will be utilized for heavy fuel oil production, but eventually will constitute the charge to a fluid coker unit.

II. *First Transformation Type of Operation—Coking of Vacuum Bottoms.* The bottoms derived from a high sulfur crude are normally without great commercial value. It is well known, of course, that heavy cracking of this product yields valuable light material and if this cracking is pushed to the limit a residue of coke is obtained. The coke yield may be estimated roughly from the Conradson carbon residue test.

These considerations, together with the fact that in the Montreal area the heavy fuel market is not an attractive one, resulted in the provision of a coker unit. However, the conventional delayed coker technique did not appear well suited to local requirements, partly because of manpower considerations and partly because the extensive use of spraying water is objectionable in winter. Consequently Petrofina became interested in the new fluid coking process developed by Standard Oil Co (N. J.). This unit will have a capacity of 3,800 b/sd and the products are listed below:

1. Gas: Disposed of to vapor recovery unit.

2. Light gasoline: Blended with the light gasoline from the topping unit.

3. Heavy gasoline: Sent to the reformer.

4. Gas oil: Sent to the catalytic cracking unit.

5. Coke: Marketed.

Second Transformation Type of Operation—Cracking. Practically all the gas

*During the period 1940 and 1953 the sulfur content of U. S. crude oil has increased 127 percent (*The Petroleum Refiner*, September 1954).

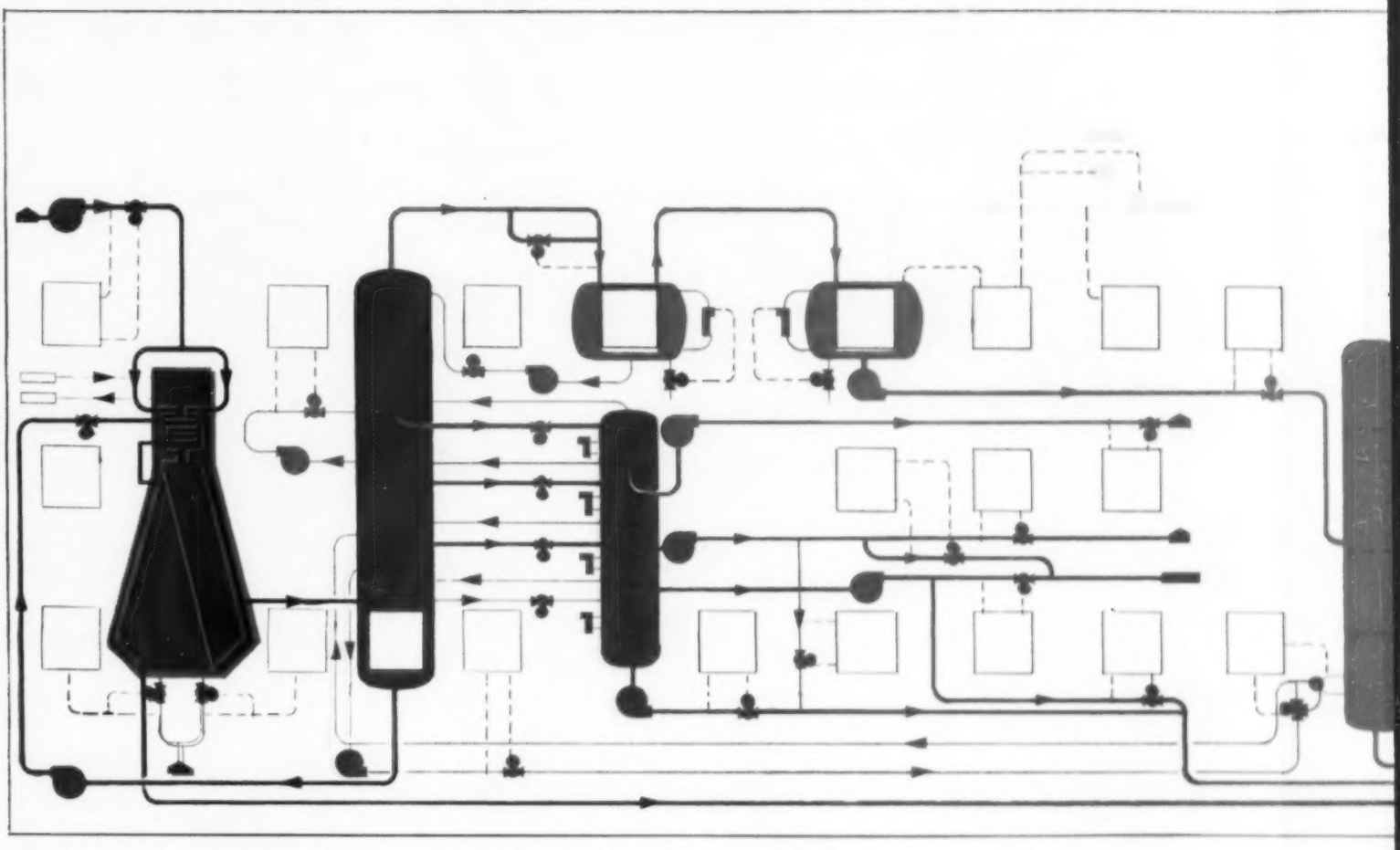
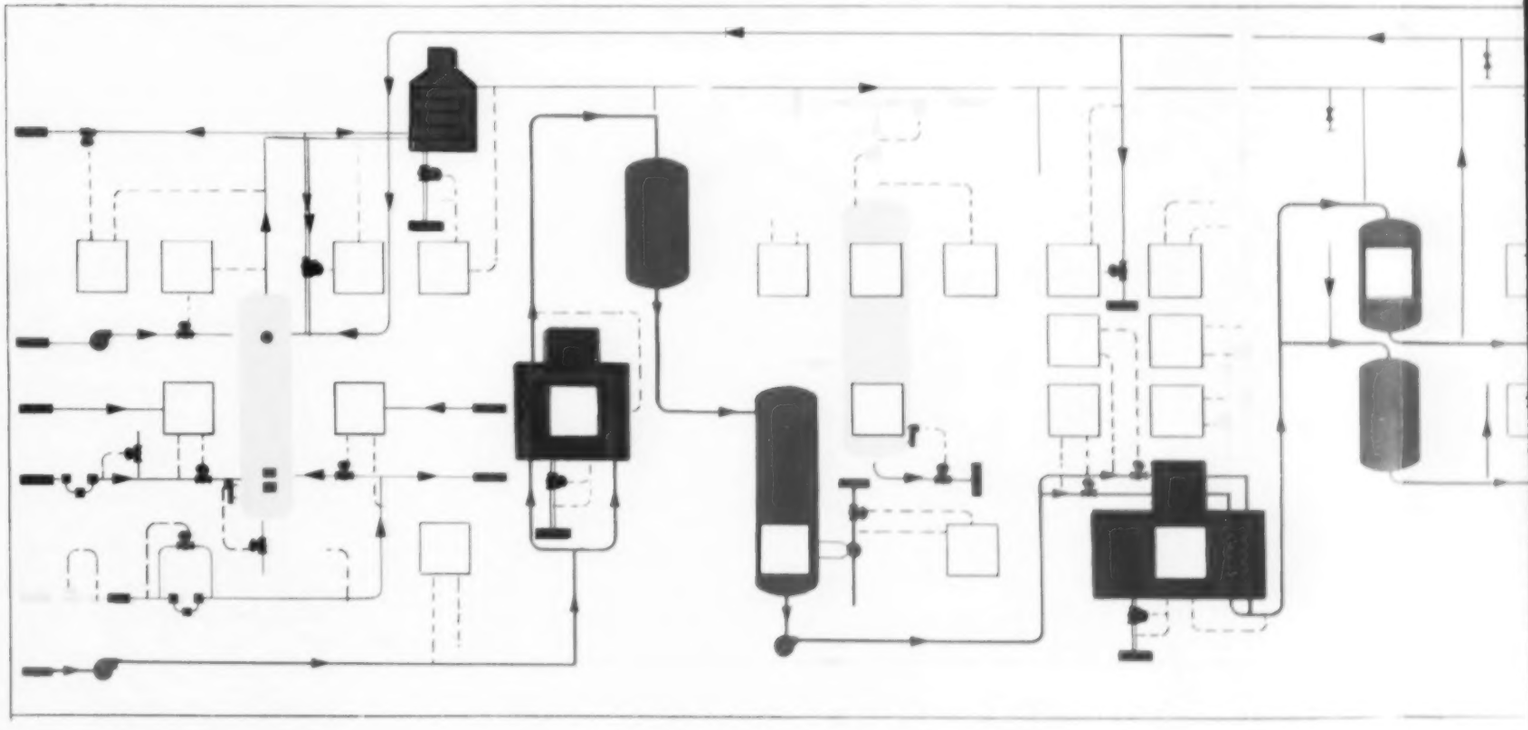
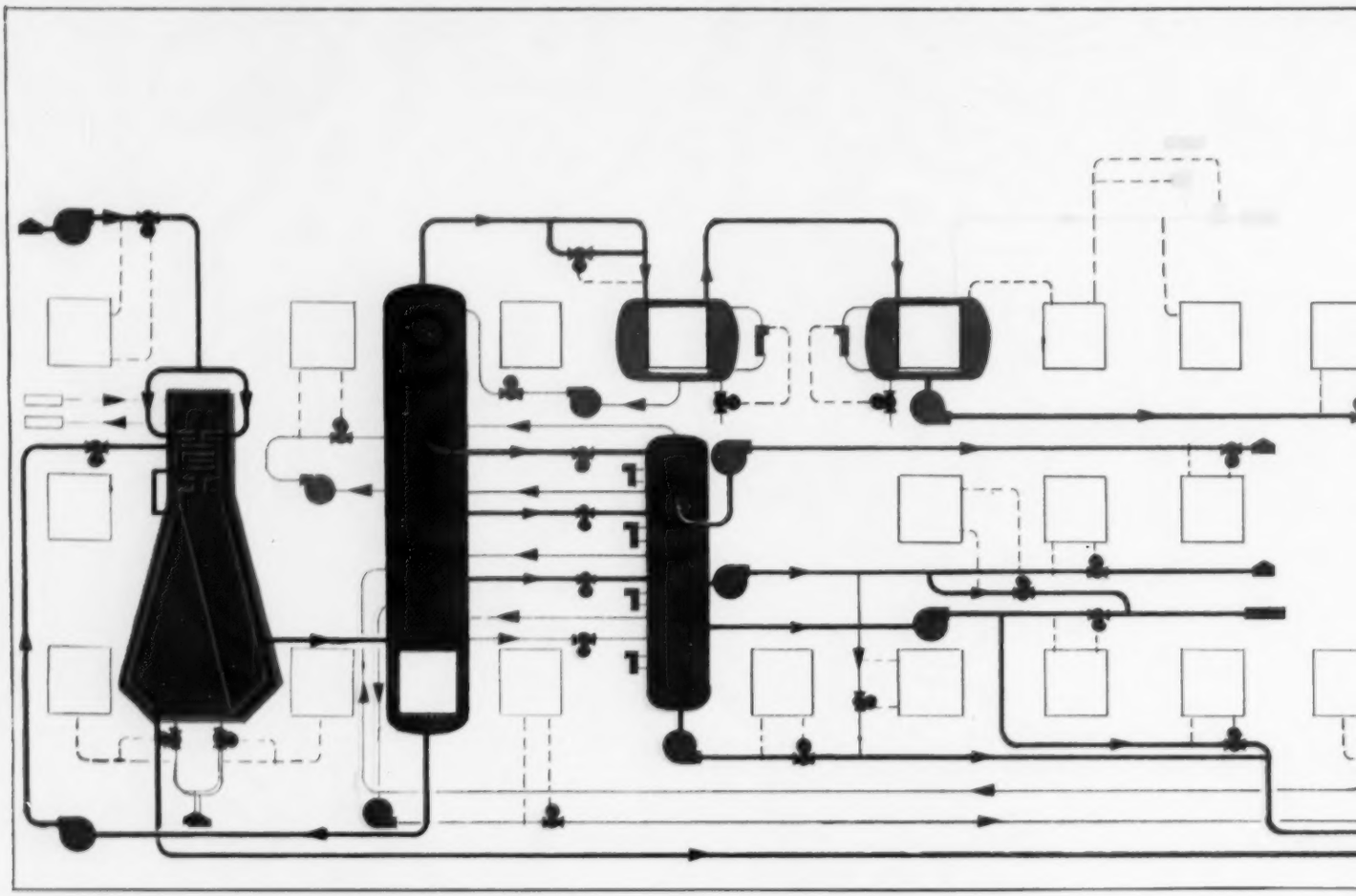


Diagram of part of the instrument and control panel being erected at the new Montreal refinery of Canadian Petrofina Ltd. The panel makes lavish use of color for easy tracing of the flow of materials. Darker colors on the board are assigned to heavier materials and lighter colors to more volatile products. For printing reasons silver has been shown here in black broken lines. The panel shown in the diagram above is of the segment devoted to the 20,000-barrel crude topping unit. As installed, it will be 21 feet long. Note the stacked side-stream strippers and the debutanizer used as a stabilizer.





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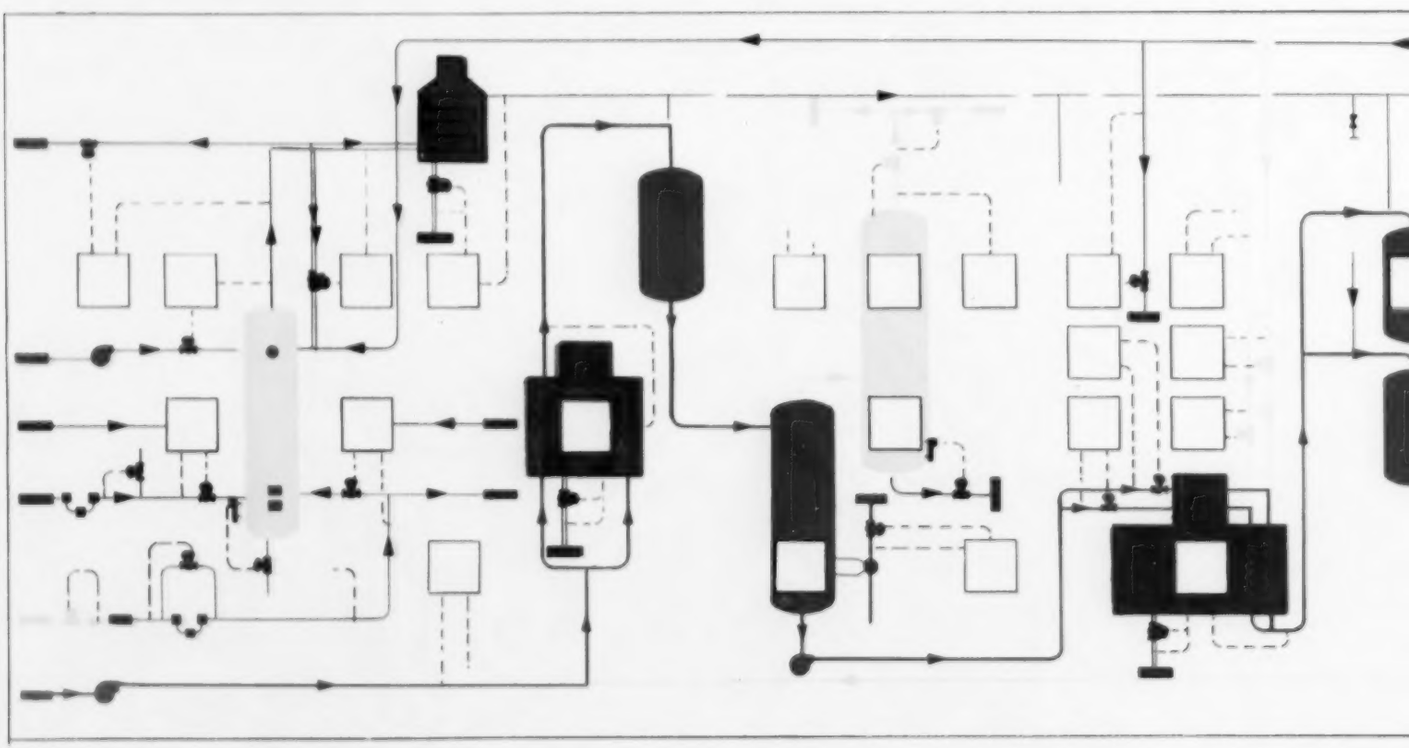
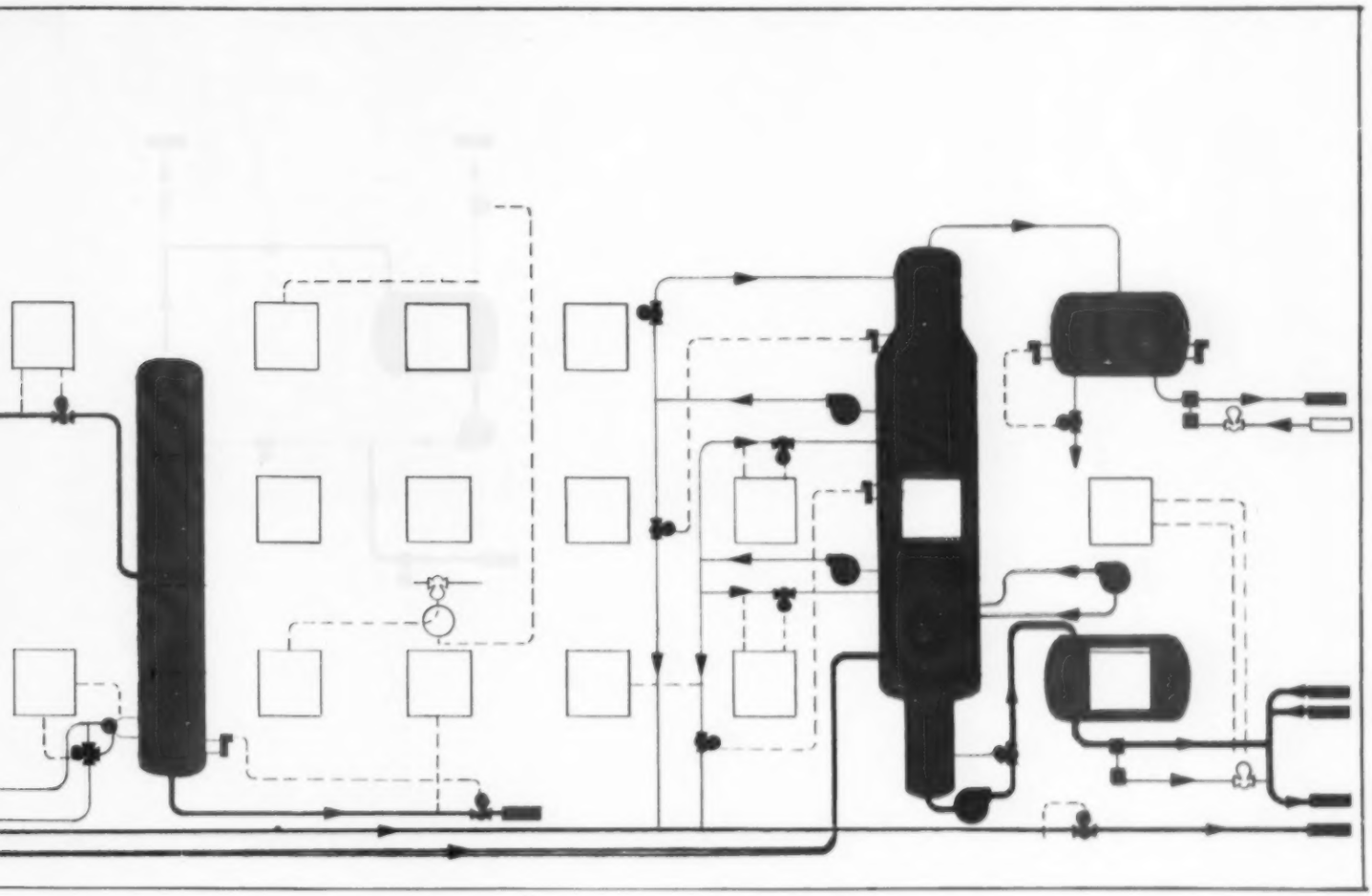
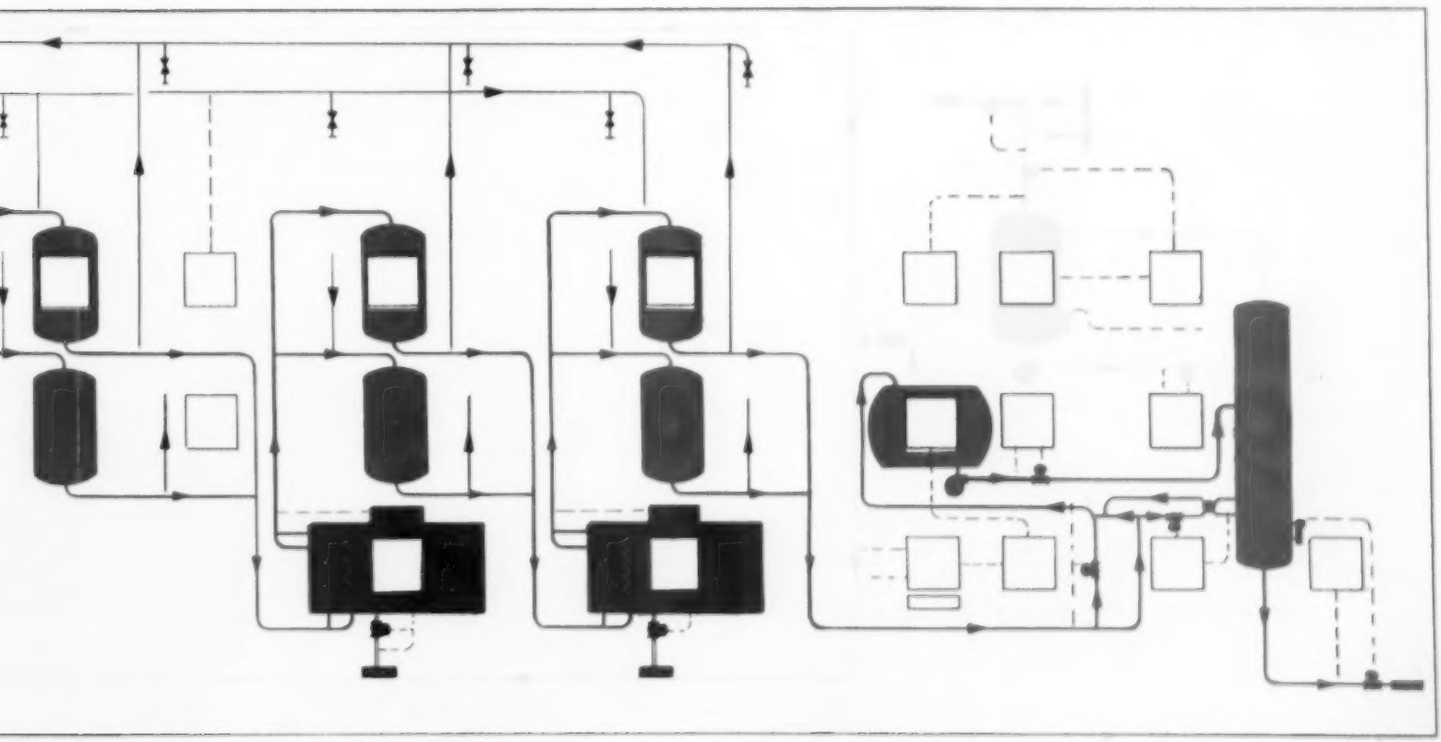
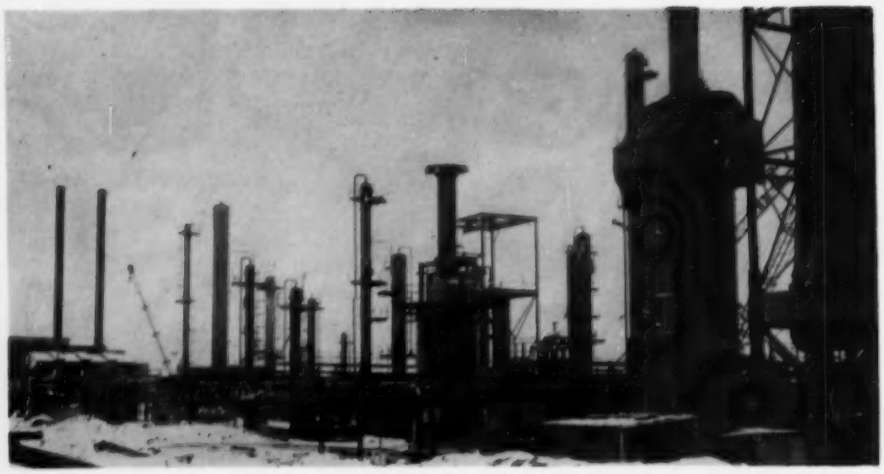




Below, diagram of the panel control board section at Petrofina's new refinery representing the catalytic reformer. The Ultraformer has three parallel sets of reactors in series for high yield. This 29-foot panel is part of a completely prefabricated Panelgraph built in Canada. Total length of all segments of the Panelgraph is 108 feet. Drawings are reproduced here through the courtesy of Panellit, Inc.



View of the cat cracker during construction work.



A general view of the refinery units in February of this year.

oils not used for diesel oil manufacture will constitute the charge to the catalytic cracking unit, where they will be transformed into gas, cracked gasoline, and cracked gas oil. A certain amount of coke will also be produced and burned in the process of regeneration of the catalyst activity. It will thus provide a fair amount of the heat needed to produce the auxiliary steam used in this cracker.

The "Houdriflow" process was selected. One of the main reasons for this choice was that, with the anticipated types of crude oil, the Houdriflow gives a yield of isobutane and butylenes which makes the provision of an alkylation unit an attractive possibility. The Houdriflow under construction in Montreal is scheduled for a total input of 16,600 barrels, 10,000 of which will be fresh feed and the balance recycle cracked gas oils. The total coke burning capacity will be 11,000 lbs/hr.

The cuts from the cracker are: vapors and gas which will be refractionated in a vapor recovery unit: light cracked gas oil which will go to the hydrodesulfurization unit; heavy cracked gas oil which normally will be entirely recycled; and bottoms to be used for HFO blending.

Third Transformation Type of Operation—Reforming. The low octane heavy naphthas will be upgraded in an Ultraformer unit licensed by the Standard Oil Co. of Indiana. This type of unit was chosen after the most careful consideration and three of the main reasons underlying this choice are:

1. The "yield octane" curve is excellent.
2. Butane production is low. This is of great importance in a cold country like Canada where the demand for bottled butane is negligible.
3. Hydrogen production is high. This hydrogen will be utilized in the desulfurization process to which further reference will be made.

Apart from this hydrogen and a small quantity of propane which will be disposed of in the vapor recovery unit, the main yield will consist of high octane gasoline which will be blended without further treatment.

Since the crude oil will have a high sulfur content, the feed to the Ultraformer must be purified. This will be done in a cobalt-molybdenum desulfurizer, part of the hydrogen produced in the reforming process being recycled with the desulfurizer feed where the sulfur will be extracted as H_2S and subsequently stripped.

The capacity of the Ultraformer will be 3,600 b/d, more than two thirds of the feed being virgin naphtha, the balance coker heavy gasoline. It may seem strange to treat this last rather high octane cut in a reformer; the reason is to desulfurize it.

Refraction—The vapor recovery unit. Besides the overhead of the hydrodesulfurization unit hereafter described, this unit will process most of the light streams mentioned before: debutanizer overhead, coker gas, Ultraformer depropanizer overhead, Houdriflow gas and gasoline and will fractionate them as indicated below:

1. Gas lighter than propane, which will be a new "transformation" hereafter described.
2. C_3 and C_4 hydrocarbons sent to a new "transformation" hereafter described.
3. Light gasoline, mainly cracked, which is caustic washed and sent to a treating unit.
4. Heavy cracked gasoline which is caustic washed.

Fourth and Fifth Transformation Type Units: Alkylation and Polymerization. The charge to the vapor recovery unit (VRU) contains a proportion of propylenes, isobutane and butylenes which may be transformed into valuable high octane gasolines, and the C_3 and C_4 cut from the VRU is used for this purpose.

Unfortunately the boiling range of H_2S approximates that of the C_3 and C_4 cut, with the result that the stream must be desulfurized before further use. This is done by means of a scrubbing solution of diethanolamine. The H_2S obtained in this way will be utilized by another company for chemical manufacture and this also reduces the risk of contaminating the atmosphere in the neighborhood with disagreeable fumes.

After H_2S removal, the C_3-C_4 cut will be further fractionated to give a propane and propylenes fraction and a butane, isobutane and butylenes fraction.

The propylenes will be polymerized in a catalytic polymerization unit of UOP design to give a high octane gasoline which will be blended. The normal propane which takes no part in this reaction will be marketed as LP Gas.

The isobutane and butylenes will be combined in an H_2SO_4 alkylation unit and the high octane alkylate thus obtained will be blended into the gasoline products. The unreacted normal butane will be stored and used to control the vapor pressure of the gasoline according to the seasonal requirements.

III. *Treating.* Apart from the sulfur and H_2S removal processes previously referred to, which may be considered as integral with their respective units, main purification processes employed in the refinery are three in number:

1. The caustic washing of gasoline

streams mainly for H_2S removal. Debutanized light gasoline, cracked gasolines and part of the stove and diesel oil production will be treated in this way.

2. Copper chloride sweetening for transforming the reactive and bad-smelling mercaptans into unobjectionable disulfides. Caustic washed light gasolines and stove oil will be treated in this way.

3. Desulfurization of middle distillates. This is the most important sweetening process of all, and the unit has to be flexible enough to cope with such widely varying products as straight run stove oil and cracked gas oil.

The Shell Development Co. process was adopted for this purpose.

The unit, which works under high pressure, is compact. An interesting feature is that the desulfurization of light cracked gas oil produces a useful quantity of high octane gasoline which, in this refinery, is fractionated in the VRU.

This 2,500 b/sd "trickle" desulfurization unit will be fed by the hydrogen produced in the catalytic reformer, and it will be recalled that the production of a rich and pure hydrogen stream was one of the reasons for choosing the Ultraforming process.

The mixture of hydrogen and distillate contacts a cobalt-molybdenum catalyst bed under high pressure and under these conditions the sulfur is removed as H_2S.

IV. *Blending.* Three types of blending have to be considered: gasoline blending, middle distillate blending and heavy fuel oil blending.

The gasoline streams which have to be considered are listed below:

1. The mixture of light straight run and coker gasoline; caustic washed and sweetened.

2. Reformer gasoline.

3. Light cracked gasoline; also caustic washed and sweetened.

4. Heavy cracked gasoline which contains the gasoline stream from the hydrodesulfurization unit. Let us remember that this stream is H_2S freed in a double-stage caustic washing unit.

5. Polymer gasoline.

6. Alkylate.

7. Butane.

It will be observed that apart from the light straight run gasoline, all of the above streams have a high octane value. Because of this the amount of tetraethyl lead required will be extremely low.

Middle distillate blending comprises stove oil, diesel fuel and furnace fuel oil. The characteristics which will determine the composition of the above products are primarily pour point, sulfur content, and diesel index and the available products from which blends will be made up are listed below:

1. Untreated, caustic washed, sweetened or desulfurized stove oil.

2. Untreated, caustic washed or desulfurized light straight run gas oil.

3. Desulfurized light cracked gas oil.

Heavy fuel oil production will be reduced to a minimum in this refinery—in fact, only that portion of the catalytic cracking tower bottoms not burned in its own furnaces will be blended to form heavy fuel oil.

Integration and Centralization. Like most modern enterprises, Canadian Petrofina thought it worthwhile to obtain a three-dimensional model of the refinery which is shown in the accompanying photograph. This was decided upon partly for construction study and partly for future training purposes.

The process units are combined and centralized to a high degree, and such things as heating oil circuits, sponge oil streams, etc., increase the interdependence among the units. Also, the intermediate tankage has been reduced to a minimum, and such intermediate tankage as does exist tends to serve the purpose of surge drums, rather than true tankage. Apart from the saving in capital expenditure, this system offers the additional advantage of minimizing heat losses in the process.

This model is multicolored as will be the refinery itself. This decision is due to technical reasons—clarity—as well as to social and psychological considerations.

The photograph shows the location of the future control-room, which will be unique. In order to get the maximum unity of action, the maximum remote information and control will be centralized there.

The principle of symbolically representing the relation between the various elements of a unit and between the units themselves has been fully developed: *all* the instruments on panels will be "figurated" (except a few in the treatment section).

The graphic panel design has been carefully studied; it had to comply with (without too much comprising) the following not necessarily compatible principles:

1. Every flow to be color coded.

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Since this graphic panel is not yet completed, we can in the accompanying picture show only how these principles have been followed for the crude distillation section.

It is the same "functional" basic idea which induced Canadian Petrofina to decide also that no pencilled log sheet will be recorded in this control room.

Automatic logging (480 points represented) will spare the operating crew the repetitious bother of copying information which in any case they have no time to record when it is the most important—in time of trouble.

Automatic logging has another advantage. It avoids any discussion after the trouble. This teleprinting will be so devised that if the value of any variable, periodically recorded, happens to be abnormal, the recording will be restarted immediately, printing in red all the "abnormal" values.

Another advantage of this device will be that some of the flows (60 of the recorded ones) will be integrated, which is convenient for accounting purposes. It is evident that such an apparatus may be considered a first step towards future programming and automation.

Facilities. In the Province of Quebec electric power is very cheap. Therefore electricity will be extensively used in this refinery. Such items as large compressors and blowers for cracker and coker (which in most refineries are steam driven) will be electrically driven here. Power will be supplied by a double source (loop), with automatic switch-over from one branch of the loop to the other in case of failure.

Water pumped from the St. Lawrence river will be recirculated (with approximately one fifth of make up) after cooling in a Fluor cooling tower.

Two 100,000 lb/hr. open air Foster Wheeler boilers will supplement the steam produced in the units.

Tankage. Crude oil unloaded from tankers or brought in by pipe line from Portland, Maine, will be stored in six 150,000-barrel heated tanks. Products will be stored in a complex of 150,000, 80,000 and 27,000-barrel tanks. Due to seasonal changes, which in this country are more pronounced than in other parts of the world, the connections to, from and between these tanks need great flexibility for storing more gasoline in winter and more fuel oil in summer.

It must be remembered that for a period of five months every year navigation is suspended by the freezing of the St. Lawrence river.

Great flexibility is also needed in product shipping facilities. Marketing requirements necessitate, at certain times of the year, shipping by St. Lawrence river tankers; at other times, truck or tank car loading; and all the year long, shipping by the Trans-Northern pipe line to the Petrofina terminals in Ontario.

Marketing buildings, administrative offices, cafeteria, etc., will be frankly modern, eliminating the grey, dull character which too often is the depressing trade-mark of industrial construction.

To this end, vivid colors, comparable to those in the process and tankage areas, will be used extensively.

The Lummus Co. of Canada is erecting the Houdriflow unit, the vapor recovery unit and the hydrodesulfurization unit. The Canadian Kellogg Co. is building the other units and the offsite facilities. Pannellit Corp. is in charge of erecting the graphic panel. The refinery is scheduled to be commissioned in the second half of this year.

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Two 100,000 lb/hr. open air Foster Wheeler boilers will supplement the steam produced in the units.

Tankage. Crude oil unloaded from tankers or brought in by pipe line from Portland, Maine, will be stored in six 150,000-barrel heated tanks. Products will be stored in a complex of 150,000, 80,000 and 27,000-barrel tanks. Due to seasonal changes, which in this country are more pronounced than in other parts of the world, the connections to, from and between these tanks need great flexibility for storing more gasoline in winter and more fuel oil in summer.

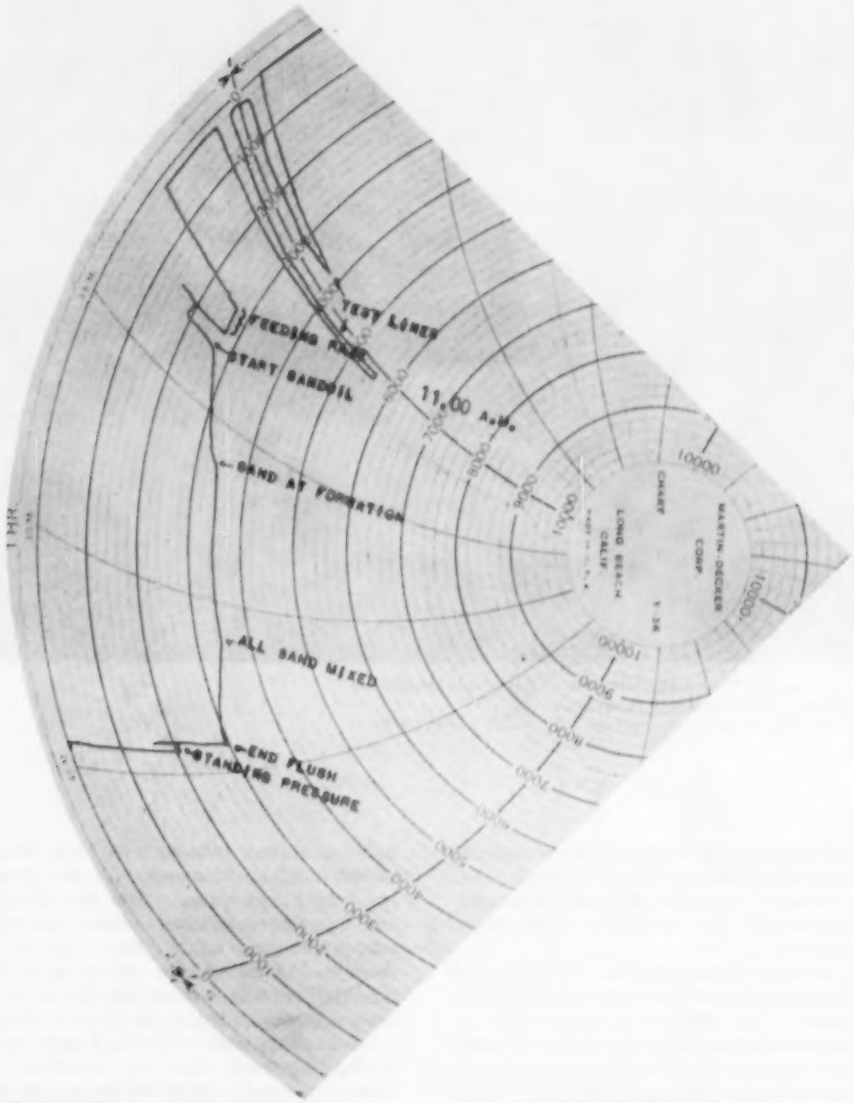
It must be remembered that for a period of five months every year navigation is suspended by the freezing of the St. Lawrence river.

Great flexibility is also needed in product shipping facilities. Marketing requirements necessitate, at certain times of the year, shipping by St. Lawrence river tankers; at other times, truck or tank car loading; and all the year long, shipping by the Trans-Northern pipe line to the Petrofina terminals in Ontario.

Marketing buildings, administrative offices, cafeteria, etc., will be frankly modern, eliminating the grey, dull character which too often is the depressing trade-mark of industrial construction.

To this end, vivid colors, comparable to those in the process and tankage areas, will be used extensively.

The Lummus Co. of Canada is erecting the Houdriflow unit, the vapor recovery unit and the hydrodesulfurization unit. The Canadian Kellogg Co. is building the other units and the offsite facilities. Pannellit Corp. is in charge of erecting the graphic panel. The refinery is scheduled to be commissioned in the second half of this year.



Portion of a typical fracturing pressure chart.

FRACTURING IN PEMBINA

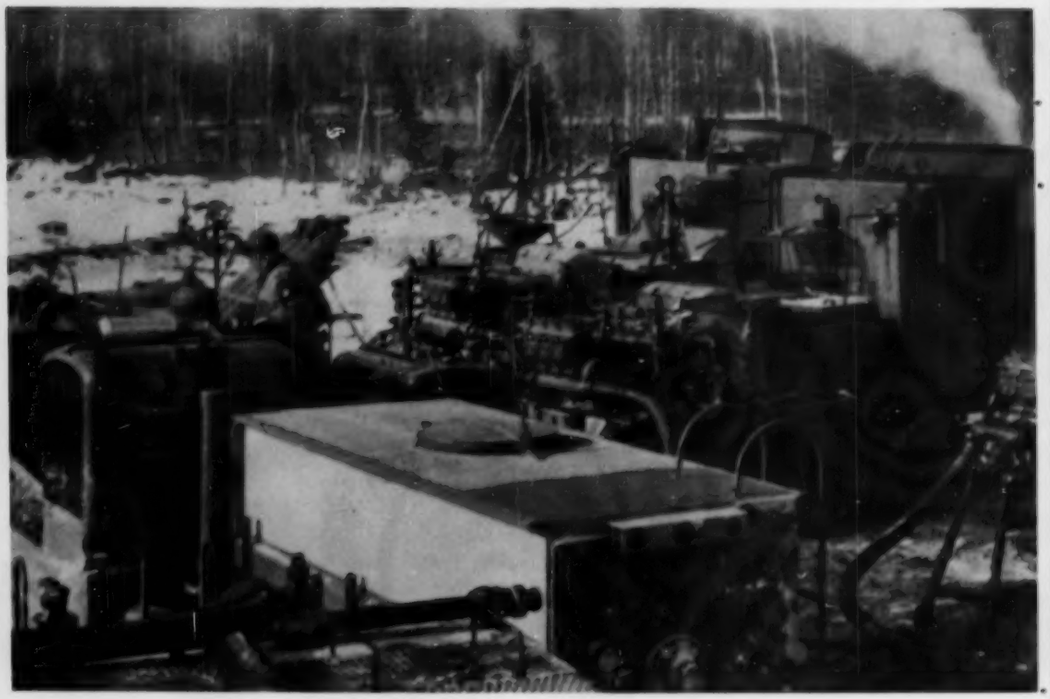
By A. R. Potter*

CANADA'S LATEST and largest field to date, Pembina, is located some 50 miles southwest of Edmonton, Alberta, in heavily wooded terrain and numerous muskegs. So far, the proven area covers over 400 square miles and is still not delineated to the south and west. Although development was restricted during the previous summer months, the activity reached a new level and continued at a high rate during the winter.

The Socony-Vacuum discovery well was spudded February 23, 1953 and drilled to a total depth of 9,425 feet by May 22, 1953. Routine drillstem test in Cardium was taken, recovering 100 feet of oil cut mud. On the basis of the E-log, production casing was set at 5,428 and perforated 5,339-57. Initial swab test yielded 6 b/d and after treating with MCA flowed 5½ barrels of oil per hour. A Sandoil type fracturing treatment was performed after which the well flowed 19 barrels of oil per hour during a short production test. There was no further activity until November 1953 and during the winter of 1953-54 it remained slow. Due to weather conditions there was practically no activity during the summer, but it resumed in full force during the winter of 1954-55 and is continuing at a formidable pace. Tremendous developments have taken place in the area both with respect to accessibility and accommodation. Model towns are being erected and a pipe line serves the area.

The oil producing horizon in Pembina is an Upper Cretaceous sand called the Cardium with promises of other prospective zones above and below. These are the Belly River (Upper Cretaceous),

*Division engineer, Halliburton Oil Well Cementing Co. Ltd., Calgary.



View of a recent "Big-Frac" treatment being performed in the Pembina field: maximum injection rate 26 barrels per minute, average 22 barrels per minute.

Viking (Lower Cretaceous), Blairmore Series (Lower Cretaceous), Jurassic, Mississippian, and Devonian. The Cardium sand lies 60 to 80 feet below the top of the Cardium zone. The reservoir consists of a conglomerate bed overlying a clean sand, below which it becomes intermingled with discontinuous shale stringers grading downward to a shale. In some areas the lower sand is also quite well developed. The porosity of this reservoir is fair, but the permeability is usually low. The bottom hole pressures are very good. Most of the wells completed so far have required fracturing to stimulate production and render them commercial, particularly where the poorer sands are shot first.

A large variety of completion practices have been utilized in the Pembina area since the discovery. Initially most wells were cored through and perforated. Usually only the lower, poorer developed sands are perforated and fractured which for the most part responded very well. The Sandoil type of fracturing utilized consisted of a bunker-diesel blend. The discovery well was treated with 3,000 gallons of fracturing oil and 3,000 pounds of sand. However, subsequent treatments increased to about 4,000 gallons of blend and 8,000 pounds of sand by mid-summer of 1954. On resuming operations in the Fall of 1954, the trend in fracturing in Pembina was to larger size treatments at increased injection rates. Various other types of fracturing fluids were introduced, particularly the emulsified lease crude variety.

Drilling practices: The Alberta Petroleum and Natural Gas Conservation Board requires that 600 feet of surface pipe be set, cemented to the surface. Due to some lost circulation difficulties experienced during the cementing of the surface pipe, it has usually been the practice to use a light weight perlite slurry followed by neat cement. Five and a half inch or seven inch production casing is used, in some cases set on top and completed open hole, although there is a definite trend to setting through and selectively perforating. Approximately 2,000 feet of fill up is required to cover 200 feet above the Belly River formation, consequently Strata-Crete or high gel cements are utilized extensively. Oil emulsion muds are by far the most popular, but water base muds are used in some instances.

On the earlier wells drilled in this area, packers were run on 2⅞ O.D. tubing and set above the Cardium sand. Completions varied, but the trend was to perforate using tubing guns and fracture with or without a rig on the location. Due to the excellent response, practically all fracturing treatments are carried out after the rig has been moved to another location. Later, however, packers were almost entirely dispensed with and open end tubing was landed above the Cardium. Some operators have utilized an extension hanger landing nipple to permit the use of extension pipe and removal of sand by reverse circulation. It is not known, however, if this has been used as yet to remove sand following a sand-out during fracturing. However, this method could conceivably eliminate the necessity of a rig in some instances.

Various fracturing techniques have been employed in the Pembina area. The main variations have been in the type of fracturing fluid used, sand concentration, size of treatment, volume of over flush, injection rates and shut-in time. Some special techniques have also been applied such as that of vertical fracturing, selective and multiple fracturing, and use of acids or surfactants ahead of the treatment. Generally speaking, the procedure involved is somewhat similar regardless of the special type being utilized, except for certain variations or modifications. Discharge lines to the well head are tested to maximum pressure anticipated or the pre-determined maximum pressure which can be used safely. The formation is broken down with crude and a feeding rate established after which fracturing fluid and sand are mixed and pumped into the formation. This is displaced with flush

oil and overflushed. The well is then shut in depending primarily on the type of fracturing fluid used. Figure I shows a typical fracturing pressure chart.

Many of the initial treatments performed in the field were performed through tubing and packers. However, packers are only used now where excessive pressures are anticipated. Most treatments are done down open end tubing and recently there has been a definite trend to treating down the annulus between the casing and tubing, in which case the treating pressures are reduced substantially and consequently higher injection rates are exerted against the sand face.

There are several types of fracturing fluids utilized in the Pembina area to suspend the propping agent and carry it back into the formation. The first used was that of a bunker-diesel blend on the discovery well. Three thousand gallons of blend and 3,000 pounds of sand were used very successfully, maximum pressure being 2,800 psi, and minimum 1,800 psi at an average injection rate of approximately two barrels per minute. Blends have been utilized fairly extensively since, due primarily to their ease of application. No preparation is required on the lease and winter temperature conditions do not materially affect the operations. Reasonably high sand concentrations can be transported without difficulty: up to 4½ pounds per gallon have been used. They have been designed to be compatible with the formation crude and usually have a viscosity of approximately 150 cps at 80°F. It has been observed that much less sand is recovered after treatment using blends and the wells tend to clean up faster. Several successful jobs have been done using formation crude, which is of paraffin base, 37-39 gravity, pour point at 45-50° F. Sand concentrations up to 1½ pounds per gallon at five barrels per minute have been pumped without difficulty with Pembina crude. There is, however, a very rapid decrease in viscosity with temperature above 50°F.

Emulsified crudes have also been used quite extensively with the fracturing processes in Pembina. Very high sand concentrations can be pumped. They have, however, been fairly difficult to prepare, particularly during cold weather, resulting in a time-consuming operation. These emulsions also exhibit the property of breaking when pumped through restrictions at high injection rates, consequently their application may be limited particularly with the "Big Frac" type of treatment being performed on some of the poorer wells in the area.

Thickened crudes without the use of water have recently been introduced with very favorable results. This Vis-O-Frac process yields a thickened field crude which is essentially a hydrocarbon gel; it is easy to prepare and is not materially affected by cold weather mixing. It also has very good sand carrying properties and exhibits exceedingly good pumping charactertisics. Although no upper limit of sand concentration has been established, four pounds per gallon has been mixed and pumped without difficulty also. This gel has been pumped at 26 barrels per minute with unbelievably low friction losses.

Propping agents: To date, insofar as is known, only the 20-40 mesh sand has been used in Pembina. It is, however, conceivable from a theoretical aspect that "tailing-in" with a coarser sand, such as 10-20 mesh, may be advantageous. There has been a definite trend, however, to larger volumes of sand per treatment and also to higher sand concentrations. Sand concentrations were usually about 1.5 pounds per gallon earlier, but they probably average over 2.0 pounds per gallon now, with maximum concentrations often approaching 4.0 pounds per gallon. On most treatments the sand concentration is tapered from ½ pound per gallon on up during the course of the job, depending on the treating pressures encountered. One operator in particular has done considerable experimental work along these lines, but no definite con-

clusions have been reached as yet. Some other operators do not feel, and possibly rightly so, that the sand concentrations are of too much consequence.

The overall size of the treatments have increased in volume considerably since the discovery of Pembina. There is quite a variance from operator to operator in this respect which makes it difficult to plot an actual trend. It is believed, however, that it is increasing substantially and those who tend to be conservative are going to somewhat larger treatments, particularly in the poorer developed sections of the field. In actuality, much more data are required to fully evaluate the optimum.

Injection rates have increased more than any single factor and are generally considered to be the most important.

Early fracturing treatments performed were 2-3 barrels per minute. These increased to 4-5 barrels within a few months, and the majority of jobs performed now vary from 7-10 barrels per minute. One treatment has been performed recently at 26 barrels per minute, and if the results justify the additional expense, there will undoubtedly be several more to follow.

Some interesting experimentation has recently been conducted elsewhere on the basis of the theory that a fluid under pressure will pass through an orifice at a steadily increasing rate until the Reynolds number is reached, at which time a very much higher pressure can be exerted without increasing the rate of flow appreciably. The results of this study could have some very enlightening effects in determining the range of injection rates required for a given set of conditions and will no doubt bear out the inherent advantages of the higher injection rate treatments. Pressure due to friction and limitations of casing and well head equipment represent obstacles which are constantly being encountered with higher injection rates.

Ordinarily, pressures encountered while fracturing in the Pembina area are not considered to be excessive, but do vary considerably throughout the field from location to location. Generally speaking, the Cardium breaks down from a low of 2,800 psi to an average high of 3,600 psi and feeds with crude at 2,200 to 2,500 psi. Abnormally high breakdown pressures are occasionally encountered. However, a small treatment of mud cleanout agent (250 gallons) is usually all that is necessary to reduce these pressures. These could be due to local plugging such as mud blocking, water blocking or possibly poor penetration on perforating. The low breakdown and treating pressures are very likely due to fracturing along the planes of weakness created by the interbedded shale laminations and possibly in some cases through the thicker shales themselves. Treating pressures are not too consistent either, but it is believed that the actual bottom hole pressure exerted against the sand face is much more consistent than observed at the surface. Average surface treating pressures vary from 2,400 to 3,600 psi and in some cases increase to 4,000 psi, which is the maximum permissible limit depending of course upon the size and weight of casing, well head equipment and whether or not a packer is being used. No bottom hole pressure recording devices have been run in conjunction with fracturing treatments as yet, but charts have been made recently showing the tubing and annulus pressures during treatment while treating down open end tubing, the difference between which should be a good approximation of the friction pressure. In a few cases using emulsified crude, the friction pressures have been tremendous, approaching 3,000 psi. Normally, with blends, the differential varies from 900 to 1,900 psi, and the emulsified crudes 600 to 1,000 psi. Vis-O-Frac has, however, been phenomenal. On one well being treated through open end tubing the treating pressure down the tubing was actually 100 psi less than the static pressure recorded on the annulus during the operations (Fig. II and III).

It would be reasonable to assume that the less horsepower expended to friction the more efficient the fracturing operation, and undoubtedly more emphasis will be placed on this phase of fracturing techniques.

The volume of flush oil used following the frac fluid and sand has been of considerable controversy. On earlier treatments performed in the area the trend was to large volumes of over flush ranging from 60 to 90 barrels. However, there appears to be a decided trend to less and less, probably in the order of 10 to 20 barrels,

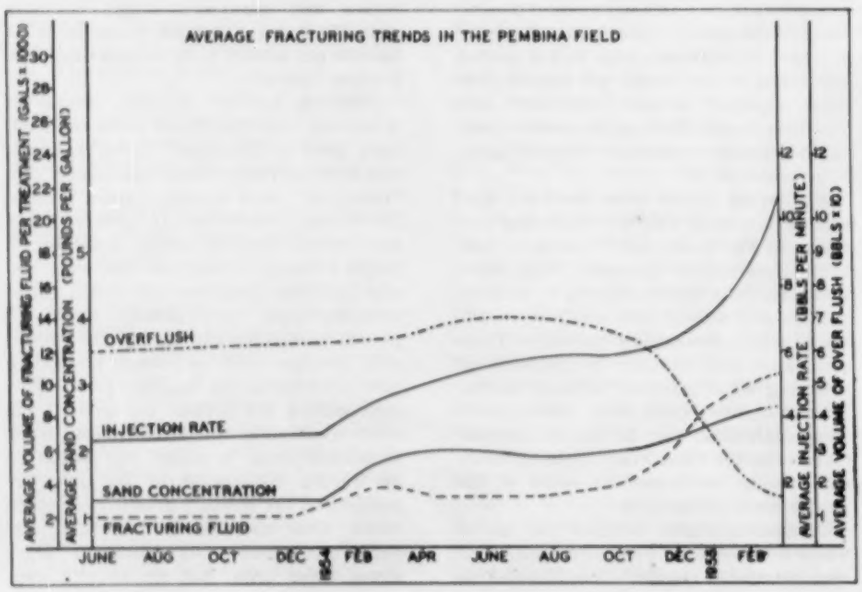
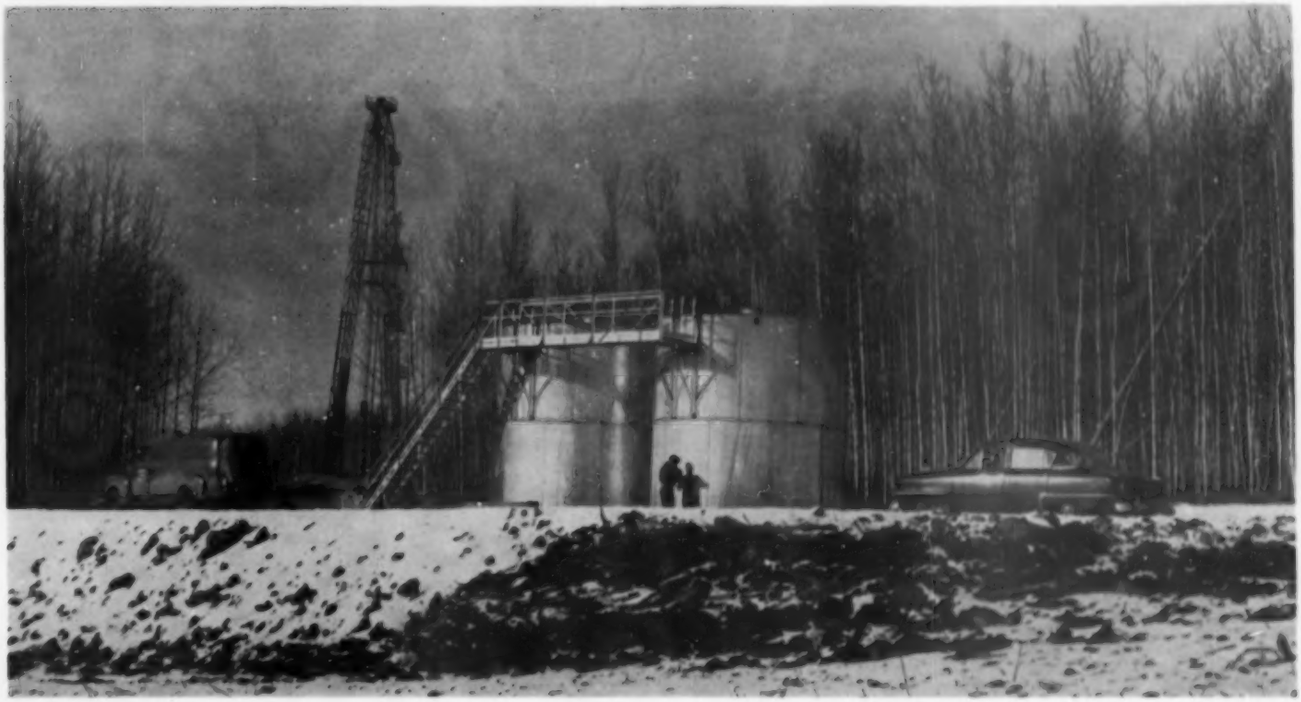


Chart prepared by the author from operating results shows average trends for the salient factors involved in the fracturing process.

Drilling rig in Alberta's Pembina field, discovered in mid-1953 by Socony-Vacuum and associates. Pembina is some 25 to 30 miles south of the Trans Mountain pipe line from Edmonton to Vancouver.



Pembina Crown "D" No. 1 is a Cardium producer. Stanolind photo.

although some operators still use fairly large volumes.

Shut-in times after treatment when using emulsified crudes have been by necessity 18 to 24 hours. With blends and the Vis-O-Frac thickened crudes, this factor is not critical. It is, however, recommended in most cases that the pressure be allowed to bleed off and dissipate into the formation, allowing the formation to relax and settle on the propping agent, before flowing the well back.

Surfactants have been used in Pembina ahead of fracturing treatments and although there isn't too much evidence so far to substantiate its use in this particular area, in others it has been observed that wells will clean up faster and produce pipe line oil quicker when employed as such. Emulsions can be formed when fracturing fluids contact the formation fluids under certain conditions. Therefore, their use is worthy of consideration and could be cheap insurance. Mud cleanout agents have been used quite frequently and effectively, particularly where abnormally high breakdown pressures are encountered. Emulsions and mud blocks left in a formation as a result of drilling and completion can cause high treating pressures and no doubt much benefit is derived by a cleaning up of the perforations, insuring better penetration through the perforations beyond the cement sheath.

Several wells have been treated using the vertical fracturing techniques, but there was very little evidence to warrant further investigation and as a result the idea has been somewhat shelved for the time being. Temporary plugging materials have been used quite widely recently in an attempt to effect multiple fracturing with at least some degree of selectivity. There is every indication that more will be used, and most operators feel that there is no doubt that they are necessary on re-fracturing treatments.

These materials can also be used to plug thieving zones temporarily, to help isolate around the shoe joint and to treat zones which cannot otherwise be isolated. Attempts have been made to fracture selectively by the use of a hydraulic open hole straddle packer, but the results have been discouraging to date. Apparently communication was occurring through fractures induced graphically or otherwise around the packer rubbers. New approaches are being studied which may offer a solution.

Attempts have been made to determine where the fractures are being created both by the use of spinner surveys and by radio-active tracers added to the propping agents. Some indications have been obtained, but no information has been released as yet. Concrete information would be of invaluable assistance in future techniques if and when such data can be made available to the industry.

Drill stem tests in the majority of cases are not too revealing, although some wells do flow initially. Excellent wells are often obtained from fracturing. Initial potentials vary from an average low of 5 to 10 barrels to an average high of 25 to 35 barrels per hour. Although there has not been too much oil removed to date, the production history for the most part does not exhibit any appreciable production decline. The allowable, as established by the Alberta Petroleum and Natural Gas Conservation Board, was an average of 105 b/d, maximum 200 b/d for March 1954. No free water is produced as yet and gas/oil ratio is reportedly varying from 200 to 450 cubic feet per barrel. There are some isolated cases of somewhat higher gas/oil ratios in certain areas of the field. De-waxing is necessary at fairly frequent intervals, but when the production is taken rapidly in a few hours per day, it is prolonged over longer periods.

Fracturing has without a doubt paid good dividends in Pembina. Many different techniques have been tried in an effort to arrive at the best method of hydraulic fracturing, but it is still too early to arrive at any definite conclusions or to establish a pattern. There have been definite trends to larger treatments, high injection rates and somewhat lower volumes of overflush. Selection of the ideal fracturing fluid for the conditions are still being evaluated for the most desirable properties necessary. Friction pressures are being observed carefully as well as the physical properties of viscosity, fluid loss, and compatability. A careful consideration of a vast amount of data will eventually yield at least some answer in selecting the most applicable technique for the Cardium reservoir in Pembina.

WORLD'S FIRST PHENOL-FROM-CUMENE PLANT COMPLETES TWO YEAR OPERATION

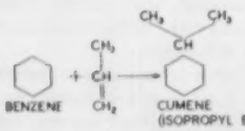
By R. H. Hall

B. A.-Shawinigan is the jointly owned subsidiary of the British American Oil Co. and Shawinigan Chemicals Ltd. The company was formed for the purpose of manufacturing petrochemicals and in 1953 its plant for producing phenol and acetone from cumene was put into operation. At that time WORLD PETROLEUM carried an article describing the company's formation and the nature of the process used. Since then the company has acquired two years of operational experience with the new petrochemical process.

Being the first plant of its kind, operational difficulties were expected and many were encountered. The most serious of these have been overcome and the plant now produces high purity phenol and acetone at and above design capacities.

Cumene, the main raw material for the process, is produced by the British American Oil Co. in a small plant within the Montreal East refinery and is sent by pipe line to the phenol-acetone plant.

Cumene is made by the alkylation of benzene with propylene according to the simple equation:



The reaction is carried out at about 500°F and 400 psi in the presence of a pelleted UOP catalyst consisting of phosphoric acid supported on kieselguhr.

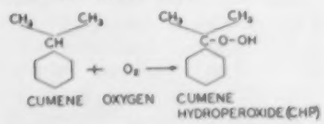
To produce the high quality cumene required, the benzene used is nitration grade and has a maximum sulfur content of 0.05 percent. The benzene used to date has been "coal tar" benzene. The propylene, which enters the alkylator as a propane-propylene mixture supplied in turn by fractionation of refinery gases, is scrubbed to remove H_2S and traces of acidic materials.

The unreacted propane is returned to the refinery for use in LPGas.

High molar ratios of benzene to propylene are used to insure maximum conversion to cumene and minimum formation of di-isopropyl benzene and propylene polymers. The reactor effluent passes through stills to top off propane, and then benzene, which is recycled. The cumene is separated from the high boilers in a final still and has the following typical analysis:

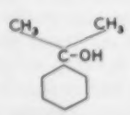
Cumene	— 99.9%
Benzene	— 0.2%
Toluene	— Trace
Ethyl benzene	— Trace
Aliphatic unsaturates	— 0.3%
Aromatic unsaturates	— 0.05%
Sulfur	— 0.005
Bromine No.	— 0.6
Sp. Gr. 20/4	— 0.8615
Refractive Index (20°C)	— 1.4909

The cumene is piped to the B.A.-Shawinigan plant where it is oxidized to cumene hydroperoxide.



The oxidation is carried out in the presence of an alkaline stabilizer in four reactors. Air is blown into the base of these reactors and controlled oxidation takes place at elevated temperatures and pressures.

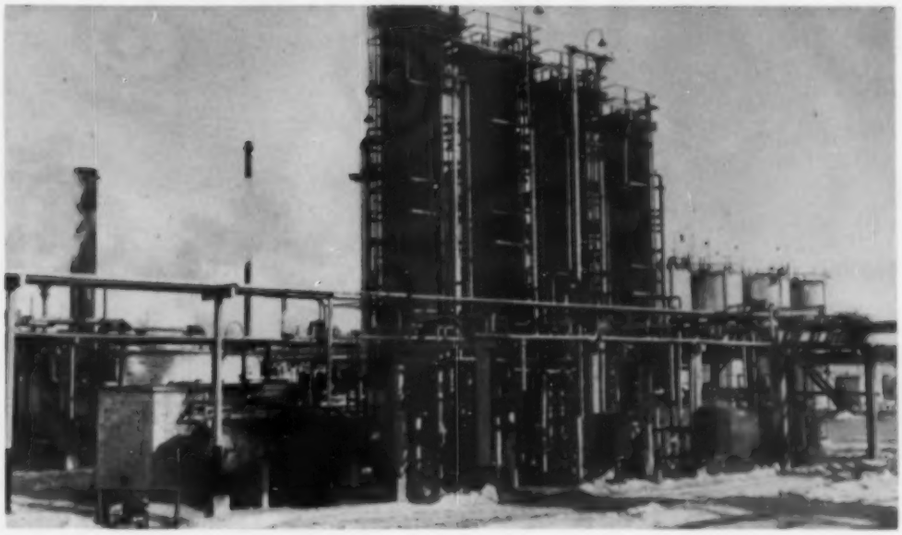
Certain by-products are formed here, the chief of which is dimethyl benzyl alcohol.



The oxidation is not carried to complete conversion and the effluent from the reactors is sent to a cumene stripper which separates the unreacted cumene from the

Panoramic view of B.A.-Shawinigan phenol-acetone plant. B.A. refinery in background supplies cumene by pipe line.

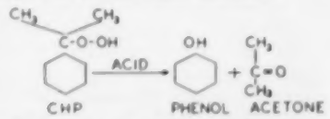
R. H. Hall was appointed general manager of B.A.-Shawinigan Ltd. in April after two years as manager of the phenol plant at Montreal East. He first joined Shawinigan Chemicals Ltd. in 1941 and was loaned to the National Research Council in 1943. In 1944 he joined the Canadian army as a paratrooper. At the close of the war he reentered the University of Toronto to earn his Master's degree before returning to Shawinigan's research department. He joined B.A.-Shawinigan in 1951 during the early design period.



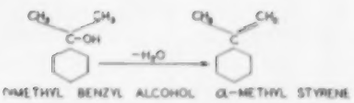
Oxidation reactors where cumene is converted to cumene hydroperoxide.

CHP. The cumene is recycled to the oxidizers.

The concentrated CHP from the bottom of the cumene stripper is pumped continually to a cleavage reactor where it is decomposed in the presence of an acid catalyst to phenol and acetone.

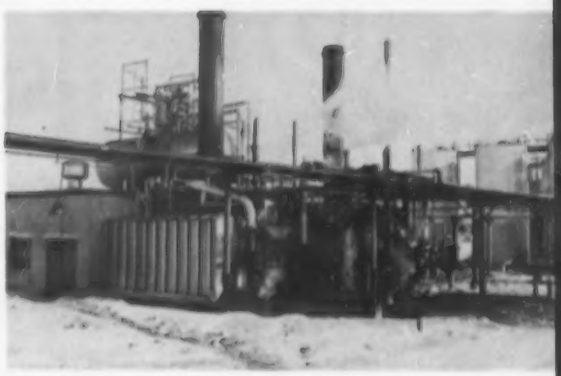


By-products are formed here, the chief of which is a ∝-methyl styrene by the dehydration of dimethyl benzyl alcohol.

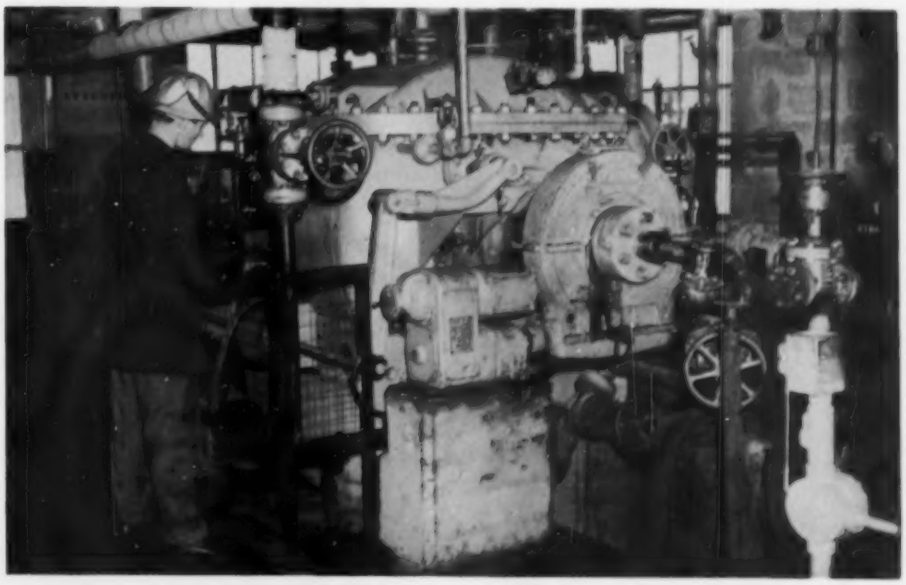


The cleavage mixture is neutralized with alkali and the insoluble salt is filtered in a continuous rotary filter.

The filtrate is fed to a primary separation still which takes a phenol-free acetone stream overhead and an acetone-free phenol bearing stream as bottoms. These streams are further purified to produce specification grade phenol and acetone. Seven additional towers are used to separate the various impurities which



Boiler plant showing outdoor construction of packaged units.



Continuous rotary filter separates salt from neutralized cleavage product.

Analyst uses a Perkin-Elmer infra-red spectrophotometer for rapid analysis of process streams.

are present. The phenol is produced to meet the U. S. Pharmacopoeia specification and acetone to meet the British Standard specification, but each of these products has a purity in excess of the demands of these specifications.

Crude α-methyl styrene is separated as a side stream and is purified in a batch-still to a purity of 99 percent.

In order to maintain the close control throughout the process necessary to insure efficient operation and high quality of products, numerous analyses are performed daily. Many of these are of the conventional type, but because of the complexity of conventional analyses for compounds like dimethyl benzyl alcohol, cumene, acetophenone, etc., in the various plant mixtures, faster optical analyses are used. Both an ultraviolet and an infrared spectrophotometer are employed for this purpose.

Steam for the plant is supplied by Foster Wheeler packaged units each rated at 25,000 lbs/hr. at 165 psig. These are of outdoor construction with the firing and control end only inside the boiler house.

Bunker oil is burned in these boilers, being supplied by pipe line from the B.A. refinery.

Plant cooling water is in a closed circuit. A Fluor cooling tower is used to cool over 2,000 gpm of water. Makeup water is taken from the B.A. refinery main which carries water from the nearby St. Lawrence River to the refinery.

Power for the plant is supplied by the Quebec Hydro-Electric Commission. Two 12,000-volt feeder lines are tied into the plant's main switching cubicle to ensure the uninterrupted service so important to a continuous process. The power is transformed to 550 volts for essentially all motors and to the conventional 110-220 volts for lighting.

The plant was designed and constructed by the M. W. Kellogg Co. Figure 1 shows the general plant layout. The railway siding and shipping facilities are seen on the right. Raw material and product storage is in the center directly behind the office and laboratory building in the foreground. The boiler plant and cooling tower are behind the storage tanks. The process unit is at the left, with the control room in the foreground. The stills surround an elongated pumphouse which houses pumps, compressors, the rotary filter, many flowmeters and control valves, etc.

The outdoor type of construction is novel for chemical plants having the winter conditions of the Montreal area. This type of construction was chosen because of reduction of first cost for process buildings and also because of the natural ventilation features of outdoor plants. As might be expected, it has been found that because of the many outside lines, most of which must be steam traced and insulated, and because of the many steam traps necessary with an extensive steam tracing system, there are some disadvantages in this type of construction from the standpoint of difficulty of operation in severe winter conditions.

Some eight miles of process piping require steam tracing and insulation, and over 400 steam traps associated with this tracing require continual checking. The failure of any trap, stopping proper steam flow in any of these tracers, can cause freezing in only a few minutes on the coldest days, particularly in lines where flow rates are small, with obvious detriment to continuous operation. However, the experience of two winters has allowed improvement and correction of the worst cases and although some extra operator effort is required, the plant can maintain high production rates through the cold weather.

The design capacity of the B.A.-Shawinigan plant is for 13,000,000 lbs/yr. of phenol and a corresponding 7,500,000 lbs/yr. of acetone. The α-methyl styrene is produced as a by-product at approximately 20,000,000 lbs/yr. or about 200 b/sd. This in turn sets benzene requirements at approximately 43,000 bbls/yr. The capacity of the cumene plant exceeds these latter figures. This plant can actually produce about 400 bbls. of high quality cumene per stream day.

Most of the phenol produced by B.A.-Shawinigan is consumed in Canada although there is a substantial export market. In the Canadian market about 80 percent of the phenol is used in synthetic resins, chiefly of the phenol-formaldehyde type, which in turn appear as molding powders for the Bakelite type of plastic or as thermosetting glues used in plywood manufacture. The next largest use, about 10 percent, is in the manufacture of lubricating oils in the petroleum industry where phenol is used as a selective extraction solvent. The remainder finds application in the manufacture of certain phenol derivatives: cyclohexanol, chlorinated phenols and alkyl phenols.

Acetone is marketed both domestically and abroad. Its chief use depends upon its powerful solvency. Its use as a solvent in the paint and lacquer industry accounts for almost 40 percent of the domestic market. Almost 30 percent is consumed by the textile industry where it is used as a solvent in the spinning of acetate rayon. The balance appears in diversified fields such as synthetic rubber manufacture, solvent for acetylene in acetylene cylinders, pharmaceuticals and plastics. A small quantity is used as an intermediate in the production of other chemicals.

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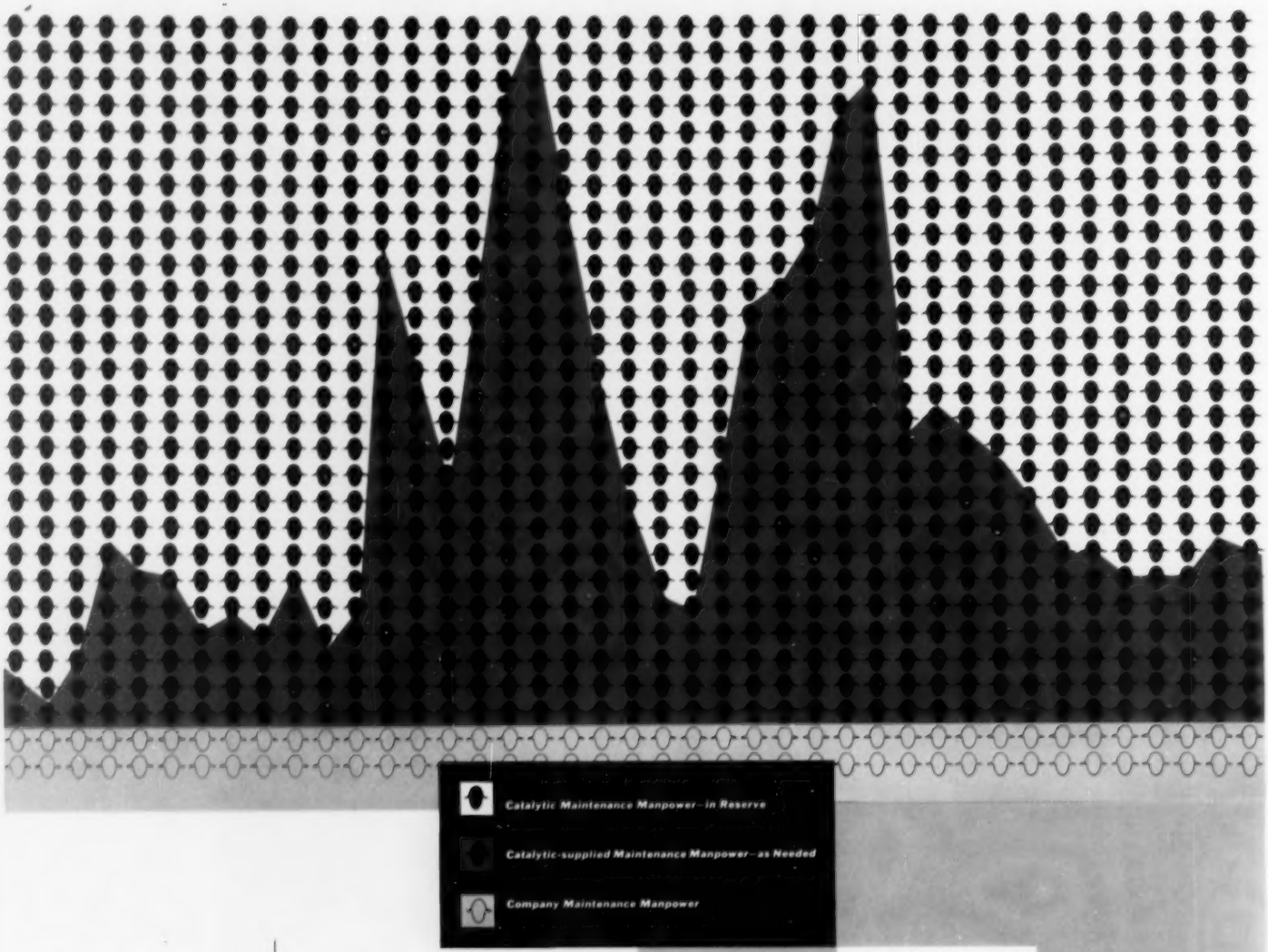

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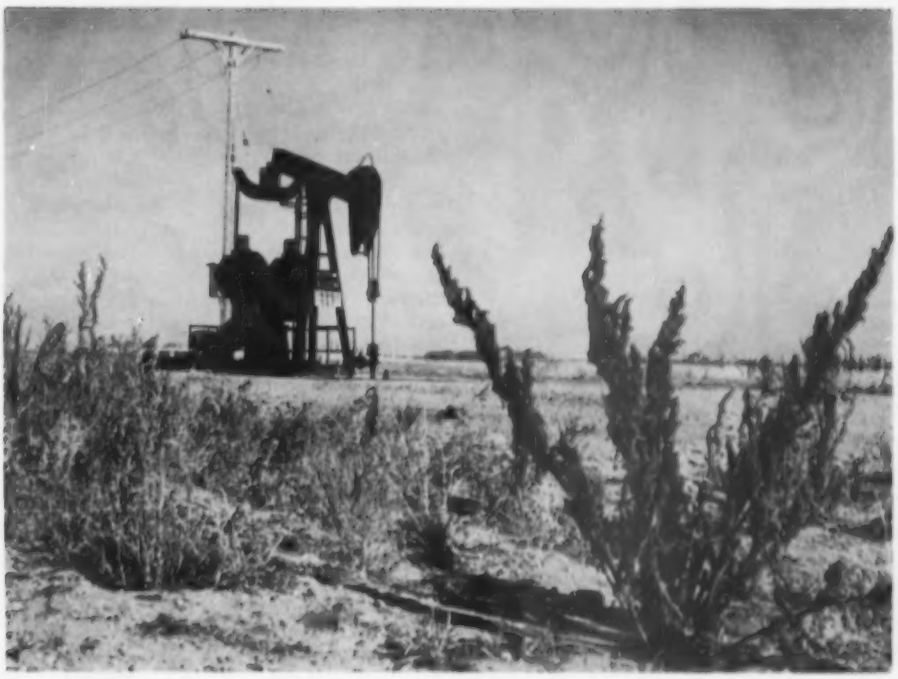
Many wells in Manitoba and Saskatchewan are being pumped with electric power. Pictured is a Shell well in the Midale field 90 miles southeast of Regina, Sask. Photo courtesy Shell Oil Co.



Manitoba operations set new record

By Leslie Orr Rowland*

SPECTACULAR INCREASES in the rate of well completions and in the number of drilling rigs at work set a record for Manitoba operations in 1954 which exceeded any single year's achievement in any area of western Canada in the entire history of this vast oil search region. A measure of maturity in Manitoba oil could be seen in the consolidation of objectives towards the Mississippian formation as the most promising horizon for success in exploratory drilling. There was a threefold increase in the current rate of crude oil production.

Well completions soared to 308 for the year's total, including 84 wildcats and 224 development wells, an increase of 200 percent in wildcats over the 28 completed in 1953 and of nearly 230 percent in development drilling over the 67 drilled in 1953. Total footage drilled, at 772,703 feet, was proportionately higher than 1953 footage of 244,832 feet. Wildcat drilling averaged slightly shallower depth, due to a smaller number of deep tests as lack of encouragement in deeper horizons kept most exploratory wells to a limit of the base of Mississippian or top of Devonian. Wildcats accounted for 239,238 feet of hole, compared with 83,525 feet in 1953, while development footage of 533,465 feet was nearly three and one half times the figure of 161,307 feet the previous year.

Production kept pace very closely with the enormous expansion in development drilling which resulted in a total of 284 wells capable of producing oil at the close of the year. Average daily production soared from 3,445 barrels in January to 8,571 barrels in December, pushing the year's total over the two million mark to 2,148,184 barrels by contrast with 1953 production of 656,181 barrels.

For January 1955, the latest month of official record, the steady progress was reflected in a rise to 8,826 barrels per day, and forecasts based on well completions in the first quarter and the same discovery rate as in 1954 indicated a possibility of crude production doubling this year over last.

Three principal factors inspired a rush of operators into Manitoba last year and a greatly increased activity by operators already in the province. The discovery rate in the second half of 1953 had been phenomenal and carried over into the early part of 1954. Out of 26 wildcat completions in this period of eight months, eight had indicated oil discovery and seven had been placed on steady production as commercial wells. The second factor was the cheap drilling cost for Manitoba wildcats, amounting to an average of $30,000 to $35,000 for the average completion depth of 2,000 to 3,000 feet. The third factor, important economically, was the ready availability of markets for Manitoba crude at a time when proration of production was being intensified in Alberta as completions ran ahead of the ability to find export channels.

This last factor is a combination of two conditions: the light gravity of Manitoba crude, mostly in the range from 34 to 36 degrees API, and the immediate proximity of the principal fields to the Interprovincial pipe line, which in fact runs right through the southeast sector of the Daly field and the whole Woodnorth field.

*Editor, *Oil in Canada*.

With scanty geological information on Western Canada's great expanse, cores are kept from as many wells as possible. Stanolind Oil & Gas Co. photo.

The wellhead price for Manitoba crude has a competitive advantage of several cents per barrel over Alberta because of the difference of some 500 miles in pipe line distance between Edmonton and Cromer station where Manitoba crude enters the line.

The completion of several exploratory projects by The California-Standard Co., pioneer in Manitoba oil operations, permitted the provincial government to receive back several blocks of exploration permit rights as Crown reserve following lease selection by the company.

This led to additional participation by other companies through purchases at the first Manitoba Crown reserve lease sale, held in July. The total cash bonus of $82,814 for the right to lease some 10,000 acres of oil and gas rights was not so important as the fact that the purchasers included Texaco Exploration Co., a new entrant into the Manitoba oil play, and Canadian Gulf Oil Co. and Socony-Vacuum Oil Co. of Canada Ltd., both major elements in Canadian oil, which increased holdings that were previously very small.

The second Crown sale, held on March 8, 1955, also drew bids from the major companies, and brought Amerada Petroleum Corp. into Manitoba for the first time with a blanket bid of $152,844 for 16,570 acres of wildcat property. These purchases should help to swell materially the wildcat completions for 1955.

A large proportion of 1954 wildcatting was done by companies which had not operated in Manitoba before. The team of Dome Exploration (Western) Ltd. and Harris Cox (former vice-president of Western Geophysical Co. of Canada) drilled 17 wildcats on a farmout of 10,000 acres from Canadian Superior Oil of Calif. Ltd. and scored three discoveries, of which one had become a defined pool by the year-end, one had been completed successfully as an oil well, and the third was suspended because of high water cut on production test.

A group of four small independent Canadian companies, Sapphire Petroleums Ltd., Henderson Oil Holdings Ltd., Select Oils Ltd. and West Canadian Petroleums Ltd., completed 14 dry hole wildcats on a large farmout of unspecified size from Cal-Standard. These two groups were both in Manitoba for the first time.

Among the previous operators, Cal-Standard drilled eight wholly-owned wildcats on its own properties and made two discoveries, one of which was suspended after a small amount of production, the other completed as a producer early in 1955. J. P. Owen, drilling contractor and operator from Overton, Texas, completed seven wildcats, making one discovery which remained a single-well pool at the end of the year. The partnership of McCarty and Coleman of Wichita Falls, Texas, drilled six dry holes on a farmout of 30,000 acres from Souris Valley Oil Co. Ltd., one of the older Manitoba companies.

The remaining wildcats were divided among a large number of companies, both major and small operators, at least half of which had not ventured into Manitoba before, and three discoveries resulted from their efforts.

Four of the 1954 discoveries had been developed into fields or pools by the end of the year. Northern Development Co. Ltd. discovered the Pierson field in the Mission Canyon member of the Mississippian formation in January. Forty miles southwest of the Daly field and closely related to the Tilston field 20 miles northwest, the field was discovered by Northern Pierson 7-11, lsd 7-11-3-29WPM which was completed at total depth of 3,274 feet (1.718 feet subsea), and at the end of February 1955 contained 12 wells.

The team of The British American Oil Co. Ltd. and Union Oil Co. of Calif., on a farmout from Canadian Superior, discovered the Woodnorth field, a few miles southeast of the Daly field, in April. The discovery well was B.A.-Canadian Superior Woodnorth 3-33, lsd 3-33-8-27-WPM, completed at total depth of 2,698 feet (1,148 feet subsea) in the Lodgepole member of Mississippian. This field also contained 12 wells at the end of February 1955.

Sooner Petroleums Ltd., a company with head office in Regina, Sask., made the discovery of the East Cromer field in August, with its Sooner Hayhurst 8-15 wildcat, lsd 8-15-9-28WPM, completed at total depth of 2,560 feet (934 feet subsea) in the Lodgepole. This pool had developed to 23 wells by the end of February 1955 and was incorporated in the Daly field by order of the Conservation Board on March 1, as drilling northwest from the discovery well and southeast from the south end of the Daly field had proven a structural connection.

A second August discovery was the Ebor pool, found by the Dome-Cox team with its Dome-Harris Cox Ebor 14-23 well, lsd 14-23-9-29WPM, three miles west of the Daly field but on a separate structure. The discovery well was completed at total depth of 2,711 feet (969 feet subsea) and by the end of February 1955 there were six producing wells.

One individual discovery well, J. P. Owen Bekker 13-32, lsd 13-32-19-25-WPM, three miles east of the Virden-Roselea field, was completed at total depth of 1,759 feet (539 feet subsea) in the Lodgepole in February and has been on steady production since the end of March 1954. Three step-out wells were dry.

Cal-Standard South Regent 6-7, lsd 6-7-4-21WPM, six miles northwest of the Whitewater oil field in south central Manitoba, was completed in December at total depth of 2,824 feet (1,177 feet subsea) in the Lodgepole and placed on steady production in January 1955. The other Cal-Standard discovery, Cal-Standard South Virden 1-12, lsd 1-12-10-26WPM, was completed at total depth of 2,405 feet (963 feet subsea) in the Lodgepole, but after producing 68 barrels of oil was suspended in March.

The Dome and Cox team made a success of its Dome et al West Ebor 13-9 discovery, lsd 13-9-9-29WPM, three miles southwest of its Ebor field, which completed drilling on December 31 at total depth of 2,761 feet (1,004 feet subsea) and went on pump production in January. The Dome et al South Harmsworth 13-26 discovery, lsd 13-26-11-26 WPM, three miles north of the North Virden field, did not have success assured at mid-March. Completed on December 30 at total depth of 2,031 feet (529 feet subsea), it was standing suspended at the last report, with production casing set, while the operators attempted to shut off water intrusion.

This success ratio of nine discoveries in 84 wildcats set a very satisfactory pace which was followed up in the first quarter of 1955 with an even higher ratio of one well on production, two indicated discoveries and one well which set casing for evaluation, out of a total of only eight wildcat completions up to the end of March.

The first 1955 discovery to go on pro-

The ship with the "Ten Mile Toot"

The sirens of the mighty "Queen Elizabeth", keyed to a lower bass "A", are audible at a distance of ten miles! The largest ship afloat certainly can make herself heard. So can Canada's oil industry. In fact, the tremendous growth of oil in Canada is making itself heard all over the world. Because of this rapid growth, it is most advantageous for business and industry to keep its finger on the pulse of Canada's petroleum giant, through Imperial Bank of Canada. We maintain a highly-skilled staff who specialize in the gathering of information on *all* phases of the industry, and Mr. A. S. deRosenroll, our resident oil specialist in Calgary, Alberta, can provide you with a wealth of information and up-to-date facts and figures. When you need information in this regard, write: Superintendent of Foreign Business, Head Office, Imperial Bank of Canada, Toronto 1, Ontario, Canada.

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duction was Imperial Virden 5-9, lsd 5-9-10-26WPM, 2½ miles southwest of the Virden-Roselea field, but on a separate structure, which completed drilling at total depth of 2,240 feet and was placed on pump after establishing open flow potential of 600 barrels per day from the Lodgepole member.

Frank S. Hallis, independent operator from Minot, N.D., completed the first discovery of the year, Hallis West Hargrave 7-16, lsd 7-16-11-27WPM, six miles north of the east side of the Daly field, at total depth of 2,432 feet (814 feet subsea) in the Lodgepole.

Cal-Standard Kirkella 13-4, lsd 13-4-12-29WPM, 14 miles northwest of the Daly field, made the first medium gravity oil discovery in Manitoba in the Lodgepole in the third week of March this year. The 23 gravity oil was recovered on a drill-stem test 80 feet into the pay zone, with a stand of 1,930 feet of clean oil.

The fourth possible discovery well was Texaco-McColl Graham Creek A-4-29, lsd 4-29-3-28WPM, three miles northeast of the Pierson field, which set production casing at total length of 3,270 feet (1,717 feet subsea) to try for Mission Canyon production. Completed at mid-March, this well was being drilled tight and no information could be obtained on its prospects.

To the extent that operators could select their areas of oil research in Manitoba in 1954, the wildcat drilling became more selective than previously, being directed mainly towards two classes of objectives: the picking up of new pools along trends between existing fields and pools, and the location of stratigraphic traps close to the line of truncation of the Mississippian rocks which runs in a comparatively straight line from the intersection of the Saskatchewan - Manitoba boundary at Township 21 to the intersection of the Manitoba-North Dakota boundary at Range 17WPM, enclosing an area of roughly 4,000 square miles of territory underlain by Mississippian. The total number of wildcats drilled in this region up to the third week in March 1955 was only 175, so that the intensity of drilling is still only one wildcat well to 23 square miles. Only two basement tests to the Precambrian granite were drilled in 1954 in or adjacent to the Mississippian region, out of the 75 dry holes which were completed.

Development drilling was 90 percent successful, 202 out of the 224 wells being completed as potential oil producers, the other 22 including four salt water disposal wells and 18 dry holes. Total number of wells capable of producing was 342 at the middle of March. Several wells in the southeast corner of the Daly field were converted to water injection wells during 1954, in the project designed to maintain production from the top well in the province, Cal-Standard Province 3-12, which by the end of January had produced more than 82,000 barrels and was still capable of making an average of more than 80 barrels per day.

Three quarters of the 1954 development drilling was done in the three Virden area fields. Daly got 68 new wells, including 64 producers; Virden-Roselea added 59, including 53 producers; and North Virden got 39, all but one producer. Cal-Standard was the dominant development operator, accounting for 126 wells, or 56 percent of total. Other wells were divided among a large number of companies.

Of sensational impact on the development drilling projection for future years, as well as on possible wildcat activity, was the first comprehensive forecast, based on geological interpretation, of producibility in the Virden area, prepared by Dr. J. C. Sproule of Calgary in July and released in October by Trans Prairie Pipelines Ltd., operator of the gathering system which serves these fields.

Dr. Sproule predicted that future discoveries of Lodgepole oil will be made in a broad region surrounding the Virden-Daly area and that his own calculation of existing crude oil reserves (recoverable) of 53.7 million barrels will be added to considerably in the next five years. Based on postulated decline curves for the three principal fields, he also predicted that a peak rate of production should be reached in 1956 at 19,800 barrels per day, followed by a rapid decline of 14,000 barrels per day in the next two years and a continuous steady decline thereafter, but that the flush production from newly discovered fields in the area will sustain the projected peak of close to 20,000 barrels per day for a period of five to ten years after the decline starts in the older fields.

Dr. Sproule forecast a depletion point for Daly at 17.5 years, for Virden-Roselea at 11.5 years and for North Virden at 17.3 years, with average recovery per well location in excess of 116,000, 88,000 and 141,000 barrels respectively.

Completion and production methods continued to be the principal problems of Manitoba operators throughout 1954, although a large measure of uniformity in completions was secured as the result of experimenting done in 1953. It is now general practice to apply Sandfrac treatment to all wells in the Daly field, in order to increase the production rate in this rather tight type of formation without bringing in excessive water. Wells are mostly completed with 15 feet of open hole below the top of the first Crinoidal zone of productivity, which is the casing point. A typical Halliburton Sandfrac job requires 10,000 pounds of sand through open-end casing, with oil added at the rate of one gallon for two pounds of sand, at pumping rate of six barrels per minute. This completion method has proved almost 100 percent satisfactory.

Wells in most of the other fields are acidized for completion, with Dowell mud-acid used in the Virden-Roselea, North Virden and Pierson fields to improve the spotty natural porosity and low permeability found in many sectors. Experience in all these fields is that zones of tightness are likely to be found in unexpected areas, so that it is a common quip among operators that an offset to a producer may easily be dry, or an offset to a duster productive. This had actually occurred in two cases in the middle of the Virden-Roselea field.

Average cost of drilling and equipping development wells in 1954 and 1955 has been $30,000 to $35,000 in the Daly field and $25,000 to $30,000 in the two Virden fields. Most wells are now electrified for pumping, and most batteries are being connected to the Trans Prairie pipe line system to provide weatherproof transportation for their oil. This small but important 32-mile line, which was laid in February and extended in December 1954, represents a capital investment of close to one million dollars and is currently carrying more than 8,000 barrels per day to Cromer station on the Interprovincial pipe line where the companies maintain input tankage.

Production allowables, although considerably higher across the board than those for the smaller Alberta fields, suffered a generally declining trend in 1954 and early 1955, culminating with a voluntary request by the Daly field operators for a reduction of the allowable from 120 to 75 barrels per day effective March 1, 1955. This reduction was ordered by the Conservation Board, in recognition of the fact that only half a dozen wells were capable of making even the reduced allowable. The principal problem which prompted the application was a severe watering-up of the flowing wells in the southwest Daly sector, mostly completed late in 1953 and the first half of 1954, most of which had been able to produce considerably more than the 120-barrel allowable in their early life.

Considerable encouragement for the productive life of these same wells was found in the fact that a bottom hole pressure survey completed in December indicated no drop in reservoir pressure since July, confirming that there is an extremely effective water drive mechanism in the area. Production tests are currently being conducted on two Cal-Standard wells, at various rates through treaters, to determine whether there is any trend in water cut in relation to different withdrawal rates. These tests are expected to provide valuable information for the guidance of future operating practice.

The current year promises to give producers a better deal financially than ever before, as they are likely to come closer to getting back in current income from production what they have spent on well drilling. Direct cost of operations last year was at least $12 million while production revenue was only $5 million after royalties. Although more wells are likely to be completed this year, the prospect is that the gap will narrow appreciably.

BP TAKES THE LOAD

WHEREVER A TRUCK may be in Britain or in Europe, it is never very far from the familiar green and yellow BP Shield.

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Canadian Petrofina to invest $62 million by end of 1955

MOST OF THE LARGE integrated petroleum companies originated in very small beginnings. Some started as small distributors or jobbers, branching out into refining and so on. Others started their activities as small producers, thence to refining and on into marketing.

Not so with Canadian Petrofina Ltd., the new and brash "major" in the Canadian petroleum industry. Legally incorporated in May 1953, Petrofina did not get started until August 1 of the same year. But since that time, barely 20 months ago, the company has set several records of achievement in establishing itself throughout the Provinces of Quebec and Ontario, where more than 60 percent of Canada's gasoline is at present sold and distributed.

The initial plans did not envisage a small beginning, by any means. Authorized capital was set at $50 million and in January of this year this was increased to $100 million.

Restless, dynamic A. F. Campo, executive vice president of Canadian Petrofina Ltd., was instrumental in persuading the parent company, Compagnie Financiere Belge des Petroles (Petrofina) S.A., of Brussels, Belgium, to extend its operations to Canada, and ever since he has been on the move.

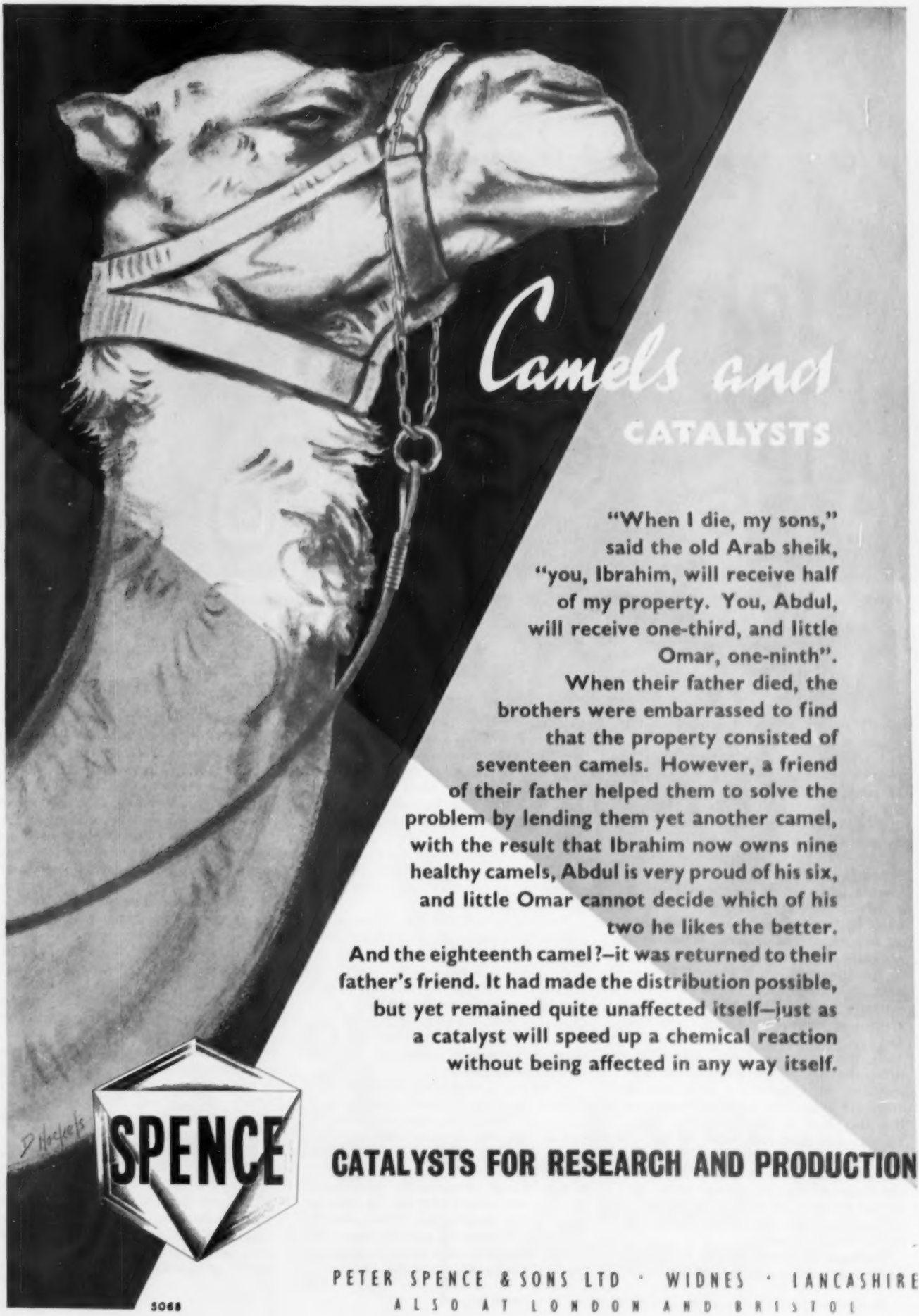
In an enterprise such as this, experienced staff is of paramount importance, and Mr. Campo has surrounded himself, as executive head of the company, with persons long in years of service in the Canadian oil industry, but still with the youthful enthusiasm so necessary in putting Petrofina quickly on the map. In addition, the parent company has furnished technical assistance, particularly in connection with the engineering and construction of the refinery.

A. F. Campo, executive vice president of Canadian Petrofina Ltd.

Standard type of the new Petrofina service station.

The parent company, commonly known as "Petrofina" throughout the free world, was formed in 1920 to take over three oil producing companies in Romania. Since that time it has grown to be a large integrated enterprise in the world's petroleum industry. Exploration and producing subsidiaries are located in Canada, Mexico, Angola and Egypt. Refining, marketing or other operations are carried on in Belgium, Canada, France, Great Britain, Greece, Holland, Italy, Luxemburg, Portugal, Switzerland, Angola, Belgian Congo, French Equatorial Africa and Tunisia. During the five years ending December 31, 1953, total net assets of the parent company increased by 149 percent, and annual net profit by 480 percent.

With this background of knowledge and experience, plus adequate financial resources and a personnel pool of trained refining and marketing people, the Cana-



Camels and CATALYSTS

"When I die, my sons," said the old Arab sheik, "you, Ibrahim, will receive half of my property. You, Abdul, will receive one-third, and little Omar, one-ninth".

When their father died, the brothers were embarrassed to find that the property consisted of seventeen camels. However, a friend of their father helped them to solve the problem by lending them yet another camel, with the result that Ibrahim now owns nine healthy camels, Abdul is very proud of his six, and little Omar cannot decide which of his two he likes the better.

And the eighteenth camel?—it was returned to their father's friend. It had made the distribution possible, but yet remained quite unaffected itself—just as a catalyst will speed up a chemical reaction without being affected in any way itself.

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Typical bulk plant, part of the new Canadian network of Canadian Petrofina.

dian company set out to build, on the Island of Montreal, a 20,000-barrel modern refinery incorporating special units for the complete processing of any kind of crude from any part of the world into high quality products. A detailed article describing this new refinery appears elsewhere in this issue.

To absorb the large volume of refined products, Canadian Petrofina immediately started an ambitious marketing program involving the construction and establishment of marine and pipe line terminals in an area extending from Rimouski at the eastern end of the Province of Quebec to Hamilton, Ont., just west of Toronto. East of Montreal, on the St. Lawrence waterway, marine terminals have been erected at Quebec City and Chicoutimi and two other marine terminals are to be built this year at Three Rivers and Rimouski. A pipe line terminal has been operating at Ottawa for some months now, and others are slated for construction this year at Kingston, Port Hope, Toronto and Hamilton.

Transportation facilities, both marine and pipe line, have become available to the company on satisfactory terms for refined products, as well as for crude oil through pipe line from Portland, Me., to the Montreal refinery.

Hundreds of retail outlets, including newly constructed company-owned service stations, have been opened in such marketing areas as Lake St. John, Quebec City, Victoriaville, Thetford Mines, Sherbrooke, Drummondville, Granby, Montreal, St. Agathe, Mont Laurier, Noranda and Val d'Or in the Province of Quebec. These are supported by strategically located bulk plants. A similar penetration of markets in the Province of Ontario is also under way in an area extending as far west as London and as far north as Timmins.

With an anticipated annual output of 130,000,000 gallons of gasoline, Petrofina officials expect that distribution facilities and retail outlets will be able to dispose of the rated capacity of the refinery when it goes into operation in a few months' time. Canadian Petrofina plans in the future to extend its marketing operations to all of the nine Provinces of Canada on the North American mainland.

To give some idea of the rapid development of Canadian Petrofina, it is expected that from the date of organization to the end of 1955 the company will have expended some $61 million for its refinery, marketing facilities, mortgage assistance to dealers and transportation equipment. Of this total, nearly $29 million will be spent on the construction of the refinery. And since its inception, approximately $32 million will have been spent on marketing facilities to the end of this year.

In the meantime the company has acquired (through exchange of stock) control of Calvan Consolidated Gas & Oil Co. Ltd. and is participating financially in the development of the Buck Lake area of the Pembina field with Great Plains Development Co. of Canada Ltd. Thus, in effect, Canadian Petrofina has become a fully integrated company with facilities for production, refining and marketing.

This remarkable development is in no small measure the brain-child of Alfredo Campo. In his 28 years in the oil business, Mr. Campo has built around himself an organization already noted for its ability to get things done with a minimum of delay. To some outsiders the working pace seems to be a bit killing. But as one of Mr. Campo's staff men stated recently, "working hard at something a fellow likes doing will never kill anyone. The trouble is there are so few hours in a day, or days in a week . . ."

With one or two exceptions, the entire staff of nearly 400 persons is Canadian.

This feeling of building from nothing, of creating new national wealth, new jobs, new ideas, has instilled fierce loyalty of purpose throughout the Petrofina staff. The combination of adequate financial support and dedicated manpower has been responsible for this new "giant" in a highly competitive industry.

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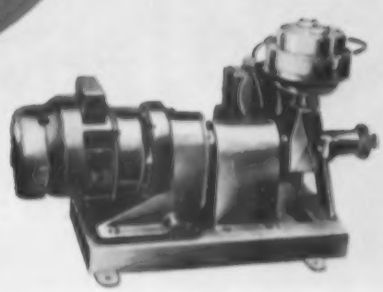
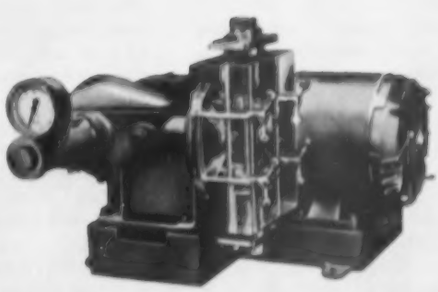
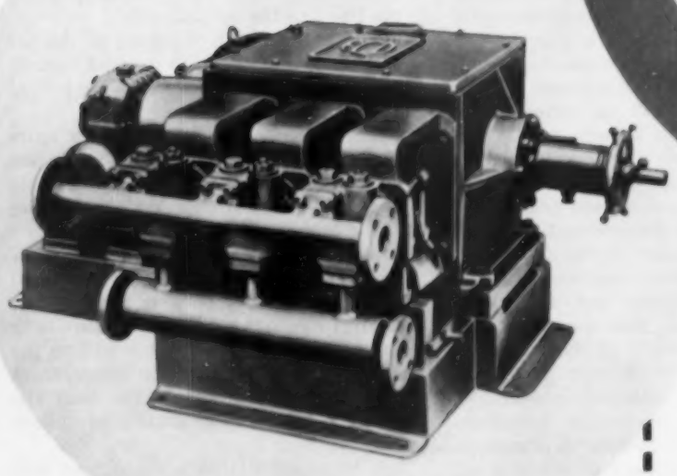




Diaphragm pump micro-capacity control with dial-type stroke adjustment indicator.



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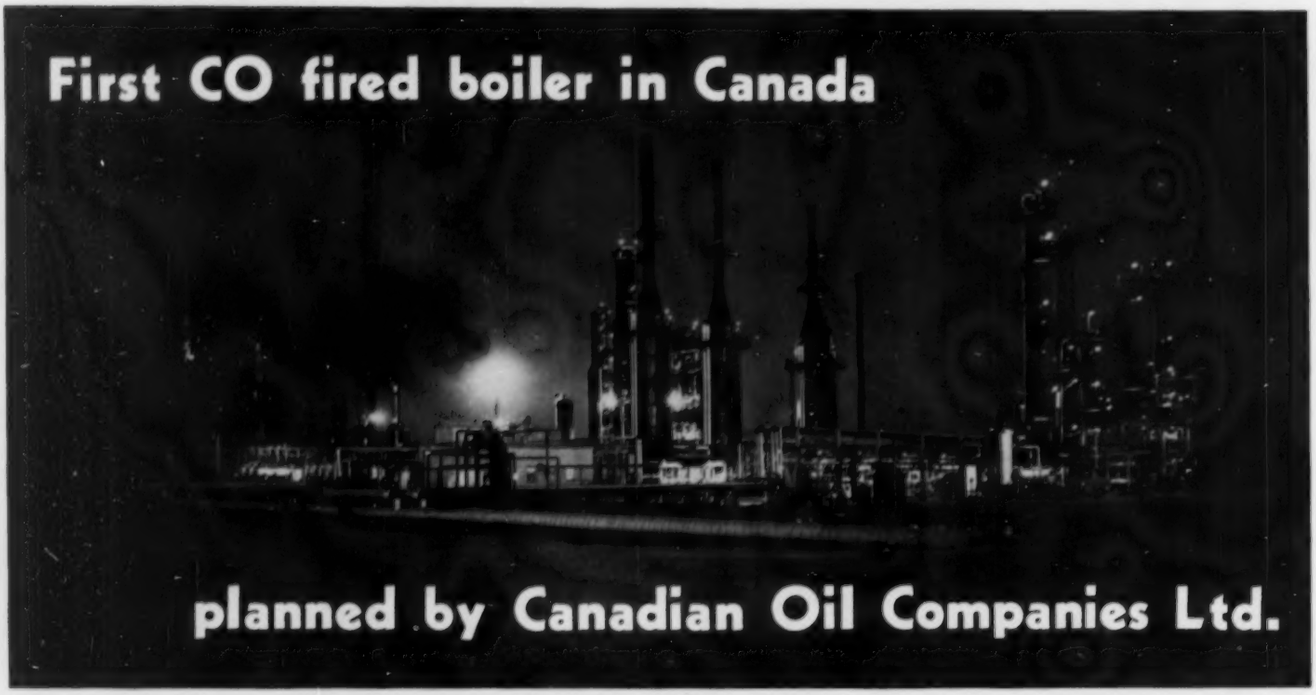


planned by Canadian Oil Companies Ltd.

WHEN CANADIAN OIL COMPANIES LTD. completed its new 2,000-barrel refinery in 1952, President W. Harold Rea and his associates felt that they were providing a substantial cushion of surplus capacity for a number of years. Since that time gallonage has continued to grow at such a rapid pace that the new facilities are becoming inadequate to take care of demand.

Recently the company announced plans to increase plant capacity by 3,000 barrels in 1956 and 5,000 barrels in 1957, bringing total crude capacity at that time to 30,000 b/d. Additions will cost about $3 million.

Included in the three-year expansion program will be the first carbon monoxide fired boiler to be installed in Canada. The $400,000 unit will burn regenerator flue gas to produce by-product steam.

Crude capacity will be increased by the addition of two heaters, one at the crude unit and one at the cat cracker. New heat exchangers will be installed to aid in supplying increased heat input.

Increased steam requirements will be provided by a 100,000 lb./hr. CO boiler using the combustion heat from carbon monoxide and sensible heat in the cat cracker regenerator gases to supply approximately 60 percent of the load.

This CO boiler installation will generate steam from catalyst regenerator gases by burning the carbon monoxide in the gas to carbon dioxide. A considerable amount of sensible heat will also be recovered.

Oil firing is necessary to induce the carbon monoxide to burn and the steam generation is due 25 percent to CO combustion, 35 percent to sensible heat pick up, and 40 percent to the oil. Adequate mixing of combustion air and regenerator gas is also an important factor in the efficient combustion of CO. In start-ups the boiler can be fired entirely on oil. The thermal efficiencies will be 74 percent for CO firing and 85 percent for oil alone.

A regenerator gas by-pass around the furnace is provided so that the cat cracker may be operated when the boiler is shut down. To ensure that no carbon monoxide can enter the boiler when work is being done on it, water seal tanks are provided in both the main regenerator gas line and the by-pass line.

The CO boiler is designed to operate fully loaded, with steam demand fluctuations taken up by the present boilers at the refinery steam plant.

The boiler itself will occupy a space 45 feet by 22 feet and will be 50 feet high, not including the stack. Combustion Engineering Co. of New York is designer of the unit.

The throughput of the catalytic cracker, an Orthoflow Type A, is at present limited by its coke burning capacity and catalyst circulation rate. To remove both limitations, a feed preheater will be installed to increase the feed temperature to approximately 800° F. The heat absorbed will be approximately 60 million Btu. per hour.

It is expected that the hot feed will reduce coke production and also allow operation at increased fresh feed rate and

reduced recycle with little loss in conversion.

Revisions to the Platformer are of a relatively minor nature and consist principally of increasing the amount of catalyst in the reactors, increasing the heat duty of the furnaces, and enlarging the hydrogen recirculation compressors.

The increased catalyst charge can be accomplished by enlarging the catalyst baskets in the reactors. It is expected that higher heat loads can be obtained by increasing the burner capacities. Larger cylinders for the hydrogen compressors will provide enough hydrogen recycle to suppress coking.

The increased flows throughout the refinery will impose a heavy load on the distillation columns. The allowable capacity of a number of bubble cap columns will be exceeded and the bubble cap plates will be replaced by high capacity type trays.

Increased steam demands will overload the present boiler feed facilities and will require additional water settling, filtering and softening equipment. Greater cooling water flows will make the enlargement of a few sewers necessary.

The crude unit heater will be a horizontally fired type, with a design heat absorption of approximately 50 million Btu/hr. The fuel will be primarily a heavy visbroken residuum having a viscosity of 750 S.F.S. at 210° F. This heavy fuel makes vertical firing unattractive.

The three vertical heaters at the crude unit are at present on primary, atmospheric, and vacuum distillation services. For the new installation it is planned to place both the primary and atmospheric heaters in primary distillation service and leave the vacuum heater as it is. The new heater would supply all the new atmospheric distillation duty with a separate coil on vacuum service to supplement the present vacuum heater.

While the new heater will be the main source of heat input to the crude, a number of new heat exchangers will be purchased and the present exchangers rearranged.

A new administration building of approximately 10,000 square feet floor area is also being planned for occupancy early in 1956, and an addition to the laboratory is scheduled for 1957.

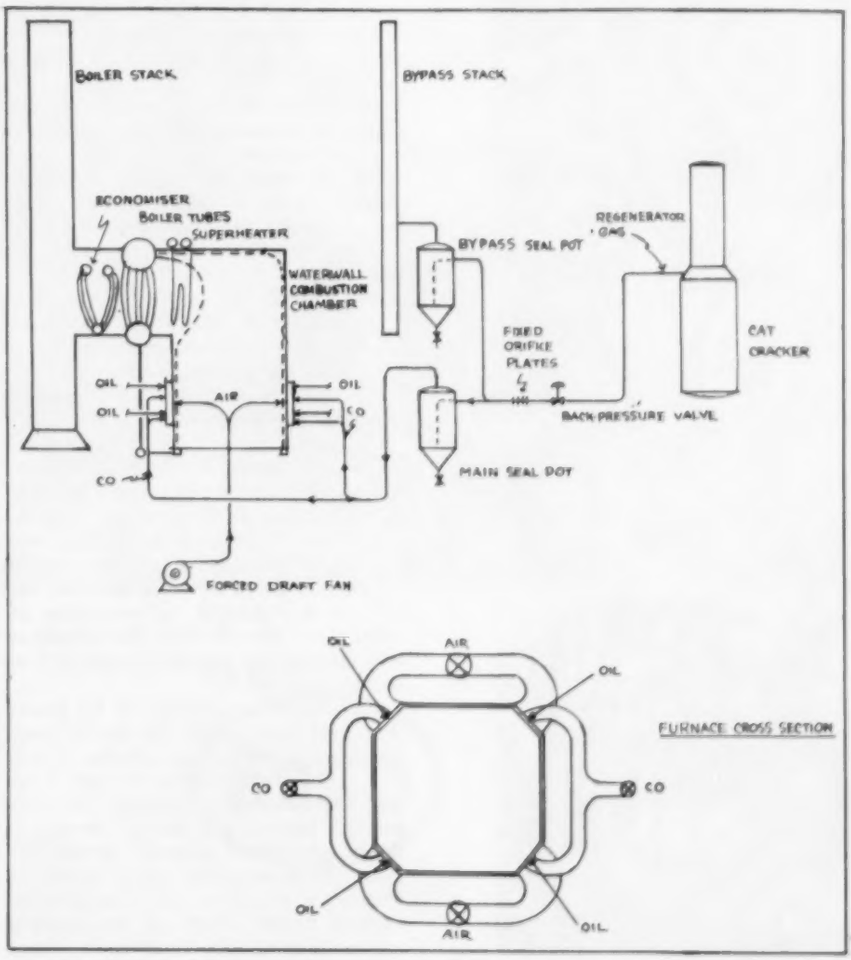
To handle the heavy engineering load, a separate engineering department has been created in the manufacturing division of the company and the engineering staff has been considerably strengthened. It is not planned to make complete engineering designs, but to have enough staff so that the direct control of the various phases of the expansion remains in the company.

Canadian Oil rebuilt its lubricating oil and grease manufacturing plant at Montreal in 1954 after it had been destroyed by fire in 1953. Among its new features is its ability to fill 300 cans a minute with lubricating oil. The plant has Canada's first oil homogenizer. Forced ventilation of all equipment and working space is another plant feature. Relocation of the laboratory close to the proportioning and mixing equipment has not only increased product control efficiency, but has also greatly reduced manufacturing time.

Canadian Oil Companies Ltd. has been expanding its marketing system rapidly. In 1954 new bulk plants were erected at North Bay, London, Windsor and Ottawa, Ont., and at Moncton, N.B. The company has 80 service stations especially designed for visibility and product identification.

Latest move of the company has been to establish a producing division with offices at Calgary. Wallace M. Luthy, formerly of Ashland Oil & Refining Co. and a veteran of 20 years in oil production, heads the new division.

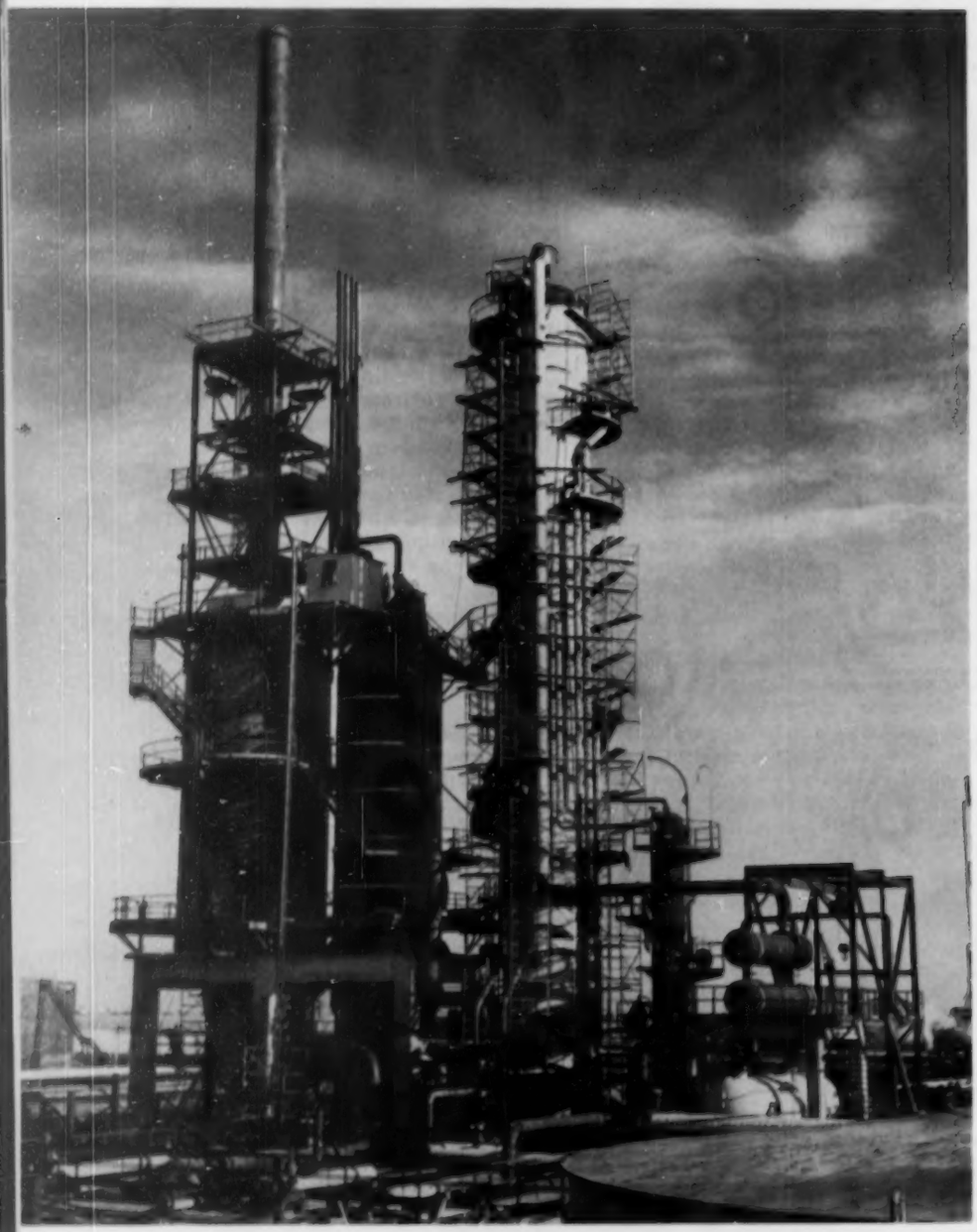
Schematic diagram of CO-fired boiler.



One of the battery of compressors at the Edmonton polythene plant of Canadian Industries (1954) Ltd. Pressures up to 2,000 pounds per square inch are employed in plastics production.

Refinery capacity expanding at 10 percent annual rate

Imperial's new fluid catalytic cracking unit at Regina has a capacity of 8,100 barrels a day. The refinery can now supply over half the petroleum requirements of Saskatchewan.



CAPACITY of Canadian refineries increased 59,750 barrels in 1954 to 566,400 b/d. At the close of the year 130,000 b/d of new crude capacity was under construction with completion planned before the end of 1956. Petrochemical plant expansion is paralleling conventional oil processing.

Indicated increase in crude capacity of Canadian refineries in 1955 is 50,000 b/d to a total of 616,000 b/d by December 31. At the end of 1956 refineries in the Dominion are expected to have a crude capacity of 670,000 b/d after retirement of obsolete stills.

New construction in progress appears adequate to take care of the rapid rate of increase in domestic demand and to minimize the need for imports of finished products from foreign refineries. New lube capacity will be particularly important from a national self-sufficiency standpoint.

In addition to new crude capacity, Canadian refiners are building a considerable number of processing units for upgrading products. The trend toward catalytic reforming is apparent. Cat cracking capacity also is continuing to rise.

Several important new jobs are going on stream this year. An outstanding example is the 20,000 b/d refinery of Canadian Petrofina at Montreal which is described in detail elsewhere in this issue.

A major $14 million expansion program at Shell Oil Co. of Canada's Montreal East refinery is scheduled for completion toward the middle of 1956. The extensions will increase the refinery's capacity from 44,000 to 55,000 b/d.

The overall expansion will be broken down into three phases. The first of these, involving an expenditure of some $4 million, will be completed by the end of this year. It includes the addition of a new vacuum flashing unit and an increase in the capacity of the catalytic cracking unit from 16,500 to 19,500 b/d. Arthur G. McKee Co. of Canada Ltd. is building the vacuum flasher. Work on the catalytic cracker is being done by Shell.

"One of the most powerful forces for international understanding and cooperation is the influence of thousands of individual businessmen working directly with the people of other countries. The basis of our growing capacity for cooperation has proved to be the rather obvious one of honestly trying to find and emphasize the many things we have in common as opposed to our differences."

—From an address by Eugene Holman, Chairman of the Board, Standard Oil Company (New Jersey)

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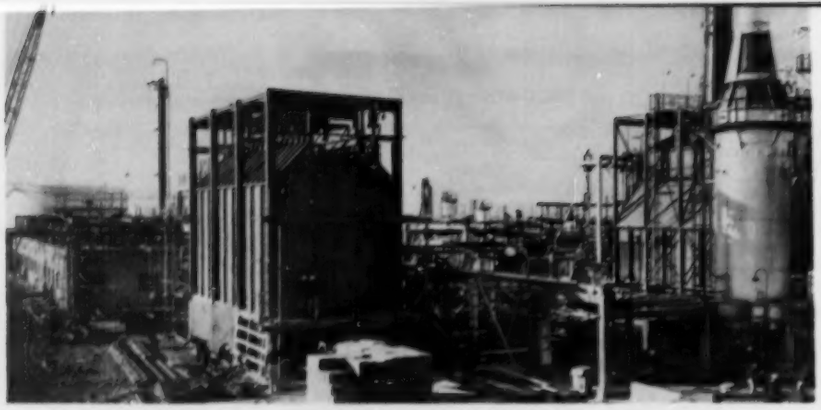
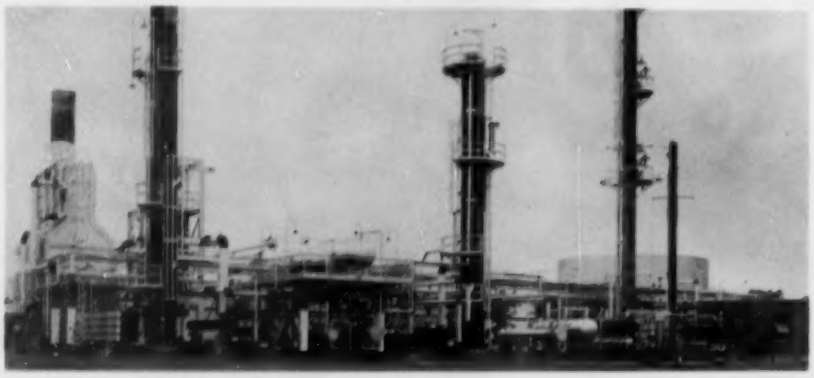


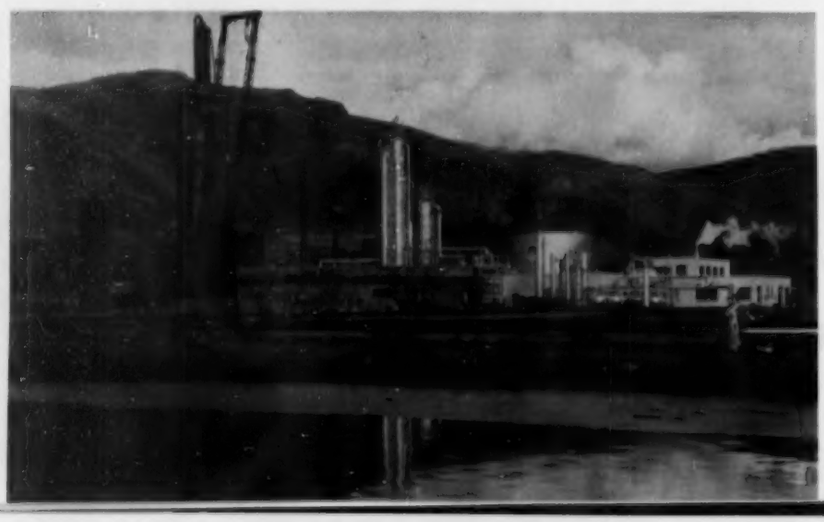
A general view of construction at McColl-Frontenac's Edmonton refinery of the 3,100-barrel thermal cracking unit with heater in the foreground. Construction of this unit is part of the overall expansion of this plant to an 11,000 b/d crude charge.



UOP Platformer recently completed by Trinidad Leaseholds (Canada) Ltd. at Port Credit, Ont.

Copper tubing back of the instrument panel at Imperial Oil's Regina refinery. The control house is one of two installed during the company's expansion program.

Loading sulfur, produced at Shell's Jumping Pound gas and sulfur plant, at Cochrane, Alberta. The sulfur is freighted by Canadian Pacific Railway to markets in the pulp and paper manufacturing industry. Shell photo.



Royalite Products Ltd. plant at Kamloops, B.C., to which a cat cracker, cat poly unit and gas concentration plant were added recently.

The second phase consists of an expansion of the crude oil distillation facilities. The two existing distilling units have capacities of 15,000 to 29,000 barrrels per day. The small unit is being completely reconstructed to increase its capacity to 26,000 barrels per day.

Arthur G. McKee Co. has also been awarded the contract for this work.

Included in the third phase is the construction of a Platformer and a hydrodesulfurizer, both of which are ultramodern improvements in refining processes. Procon (Canada) Ltd. will begin construction this summer.

Shell's Montreal refinery will be first in the world to apply hydro-desulfurization to heavy cat cracker feedstock.

Major additions to utility and offsite facilities estimated to cost over $4 million are required to support the overall program. A contract for this work has been awarded to Fluor Corp. of Canada Ltd. and includes a new cooling water tower with a capacity of 18,000 gpm, two new steam boilers of 60,000 lbs./hr. capacity each, added crude and product tankage, and a new electric power distribution system.

The current program at Shell's Montreal East refinery is the third major enlargement within the past five years. In 1950 a $16 million modernization program increased the plant's capacity from 16,500 to 25,000 b/d. Subsequently, through further alterations, the capacity was raised to 44,000 b/d. A fourth substantial investment by Shell at Montreal has been the petrochemical plant built in 1952 and now operating at full capacity.

Imperial Oil Ltd. is engaged in major construction work at four of its nine Canadian refineries. Two of the jobs will not be completed until 1956. These are the expansion at Imperoyal and the lube plant at Edmonton.

The Imperoyal construction program involves almost a complete rebuilding of Imperial's Halifax, N.S., refinery which first was built in 1918. At present the plant has a capacity of 18,000 b/d featuring tube and tank thermal cracking. The $25 million building job involves construction of an atmospheric and vacuum crude unit with a rated capacity of 41,625 b/d, a 15,200-barrel fluid cat cracker, a 3,150-barrel naphtha reformer and a 10,625 b/d visbreaker. Foster Wheeler Ltd. is building the utilities and process units. Completion is planned for mid-1956.

Second 1956 plant is the $14 million lube plant on which construction was begun at Edmonton last July. This will be the second largest lube plant in Canada, capable of producing 750,000 barrels of oil yearly. The project includes phenol and ketone units and a hydrofinishing plant.

That's the long-life valve on sulphuric acid

THE CASE HISTORY: At a large midwestern refinery there were recently two valves of different makes on a 90% sulphuric acid line. As seen in the photo above, these valves worked under identical conditions, almost side by side—each operated about three times daily.

Less than a year in the line, the valve at left started leaking, with the leak getting rapidly worse. In contrast, the Crane No. 475½ all-iron gate valve at right, with two years' continuous service to its credit, was still giving completely good performance.

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Packaging and warehousing facilities also are being built.

The two jobs being completed this year include a cat poly unit and naphtha fractionator at Ioco, B.C., and a large project at Montreal. Capacity at Montreal is being enlarged about 25 percent by installation of an atmospheric and vacuum unit rated at 41,400 b/d, a vacuum pipe still of 11,100 b/d capacity and enlargement of cat cracking capacity to 19,500 b/d. Crude charging capacity at Montreal will be 60,000 b/d when all units are tied in. Most of this work was completed during April.

Canadian Oil Companies Ltd. is engaged in a three-year expansion program at its refinery near Sarnia which was completed only three years ago. Details of this expansion are given elsewhere in this issue.

Trinidad Leaseholds (Canada) Ltd. is another company which is suffering growing pains. During the past year Trinidad built a 2,300 b/d Platformer to upgrade gasoline. The plant was much too large when compared with the refinery crude capacity of 8,000 b/d. This year the company plans to increase crude capacity to 14,000 b/d and eventually this will be extended to 20,000 b/d. Trinidad now has a 4,000 b/d thermal cracker but it is planned to build a catalytic cracker with appropriate vacuum facilities for feed preparation.

Until recently Trinidad has been processing crudes from the Caribbean. Some western Canada crude now is being run and it is the hope of the management that the Interprovincial line will be extended to the Toronto area to facilitate year-around crude deliveries by pipe line from the west.

British American Oil Co. Ltd. is currently taking a breather as far as construction of new crude capacity is concerned. Demand is creeping up on capacity, however, so that it has been necessary to start planning for new stills. Currently the company is concentrating on construction in the field of special units for produce improvement.

B-A began building its first catalytic reforming unit in 1954 at Calgary. The 2,000-barrel unit was ready for operation in February of this year. In November a second unit will go on stream at Montreal. This will be a 13,000-barrel reformer.

McColl Frontenac Oil Co. Ltd. is building a 12,000-barrel catalytic reformer at its Montreal works. The unit is being built by Procon of Canada Ltd. and will be ready for operation this summer.

On the prairies, McColl Frontenac is expanding the crude capacity of its Edmonton works to 11,000 barrels. A 3,100-barrel thermal cracking unit is being built at this plant by Canadian Kellogg.

Largest new increment to refining capacity on the prairies this year will be the 12,000 b/d refinery now under construction at St. Boniface, Man., by North Star Oil Co. Ltd. Completion is planned during July. At the close of 1954 the plant had a crude capacity of 4,500 b/d and was equipped with thermal cracking and reforming facilities. Older facilities will be dismantled when the new refinery is completed.

Wainwright Producers & Refiners Ltd. completed a 3,000-barrel skimming and asphalt plant at Wainwright, Alta., in February. The combination topping, visbreaking and vacuum unit cost about $700,000. The Fluor Corp. was contractor on the job.

Anglo-Canadian Oils Ltd. is building a 1,000-barrel Platformer at its 3,000-barrel refinery at Brandon, Man. Procon is contractor. Completion is planned for June.

Royalite Products Ltd. recently completed final phases of construction at its Kamloops, B.C., refinery which began operating on a limited basis last year. New units included a catalytic cracking unit, poymerization unit and gas concentration plant. At the Coleville, Sask., refinery Royalite is planning a vacuum unit for the production of asphalts.

Standard Oil Co. of British Columbia Ltd. activated its enlarged plant at Burnaby last October. The new $10 million installation with a crude charging capacity of 11,000 b/d consists of a two-stage crude unit, 3,750 b/d catalytic cracking unit, 900 b/d cat poly unit and gas recovery facilities. The plant was built on a 75-acre site not far from the original Stanovan refinery completed in 1935. Fluor Corp. of Canada built the Model IV cracker and the gas recovery and treating equipment.

Husky Oil & Refining Ltd. is expanding its operations in the refining field. Most recent company acquisition was the Trans Empire Oils Ltd. refinery at Moose Jaw, Sask. The Trans Empire plant, with a capacity of 1,800 b/d, was built in 1949. The new owners are expanding crude capacity by the erection of a 3,000 b/d visbreaker vacuum unit, and will build a Catformer and hydrodesulfurization unit. The company also purchased the 1,200-barrel Riverlake Oils Ltd. refinery completed in December 1952 at Fort William, Ont. This plant is to be enlarged to 4,000 b/d and to be equipped with a Catformer. Husky previously operated an 8,500 b/d skimming and asphalt plant at Lloydminster, Sask. Husky issued $10 million in new bonds and debentures later in 1954 to finance the new refinery purchases and expansion.

Excelsior Refineries Ltd. broke ground last November for a $1.5 million thermal cracking unit to be erected at Dawson Creek, B.C. Dawson Creek, known as Mile Post Zero on the Alcan Highway, is the crossroads for all traffic to and from Alaska. It is located 470 miles west-northwest of Edmonton.

Light crude from the Sturgeon Lake and Fort St. John oil fields will be processed in the 2,000-barrel plant, which is expected to be in operation by July 1955. Excelsior also operates a 3,000-barrel asphalt plant at Lloydminster.

The $15 million Edmonton polythene plant of Canadian Industries (1954) Ltd. was opened officially on October 14, 1954 by Hon. E. C. Manning, premier of Alberta.

The polythene plant, construction of which was started by Poole Construction Co. Ltd. of Edmonton, is the first plant in Canada to manufacture this plastic. Manufactured here by the polymerization of ethylene derived from the ethane in Alberta natural gas from the Leduc oil field by way of the natural gas conservation plant at Devon, polythene is used in the manufacture of pipe, wire and cable insulation, containers, transparent film, "squeezable" bottles, toys, and many other applications. Canadian consumption is expected to hit 12,500 tons in 1957.

Consisting of 14 main buildings and a considerable quantity of uncovered equipment occupying more than 40 acres of a 300-acre property, it employs 250 people and its operation involves an annual expenditure in Alberta alone of well over $2 million for materials, wages and services.

Ethyl Corp. of Canada Ltd. has announced plans to build at Sarnia a multi-million dollar plant to manufacture tetraethyl lead. The plant site of 100 acres is adjacent to that of Canadian Oil Companies Ltd. and to the St. Clair River.

It is expected that the new plant will be completed and in production by the early part of 1956 and will employ about 150 people. A small number of key supervisory people from Ethyl's plants at Baton Rouge and Houston will be used on a temporary basis for initial staffing and start-up of the new plant, but subsequently the plant will be operated as completely as possible by Canadian personnel.

The boom in synthetic ammonia production is spreading to Canada. At present there are three such plants operating in the Dominion. Sherritt Gordon Mines, Inc., produces ammonia and ammonium sulfate at a $24 million natural gas plant at Fort Saskatchewan, Alberta. The plant began operations in June 1954. Capacity is 50,000 tons per year of ammonia. Ammonium sulfate is being produced as a by-product of the treatment of nickel concentrates from the company's mine at Lynn Lake, Man.

At Calgary, Consolidated Mining and Smelting Co. of Canada Ltd. is producing about 130,000 tons per year of ammonia. Ammonium nitrate is produced.

A third plant in the west is being considered, but has not been firmed up as yet. In Ontario Dow Chemical Co. produced 100 tons of ammonia daily at Sarnia.

In the east, Quebec Ammonia Co. Ltd. has let a contract to The Lummus Co. for the erection of an $8.5 million ammonia plant at Contrecoeur, near Montreal. The plant is to have a capacity of 120 tons per day. Heavy fuel oil will be used.

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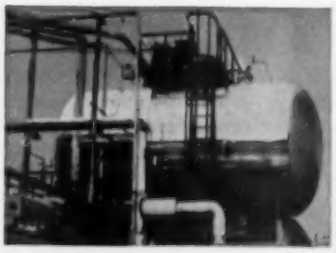

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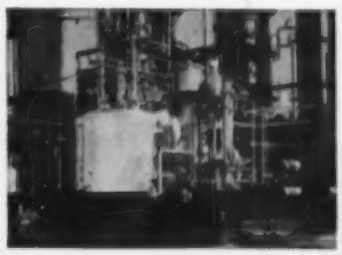

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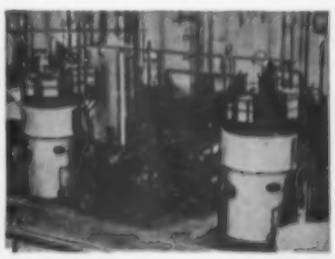

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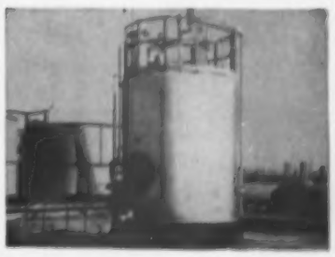

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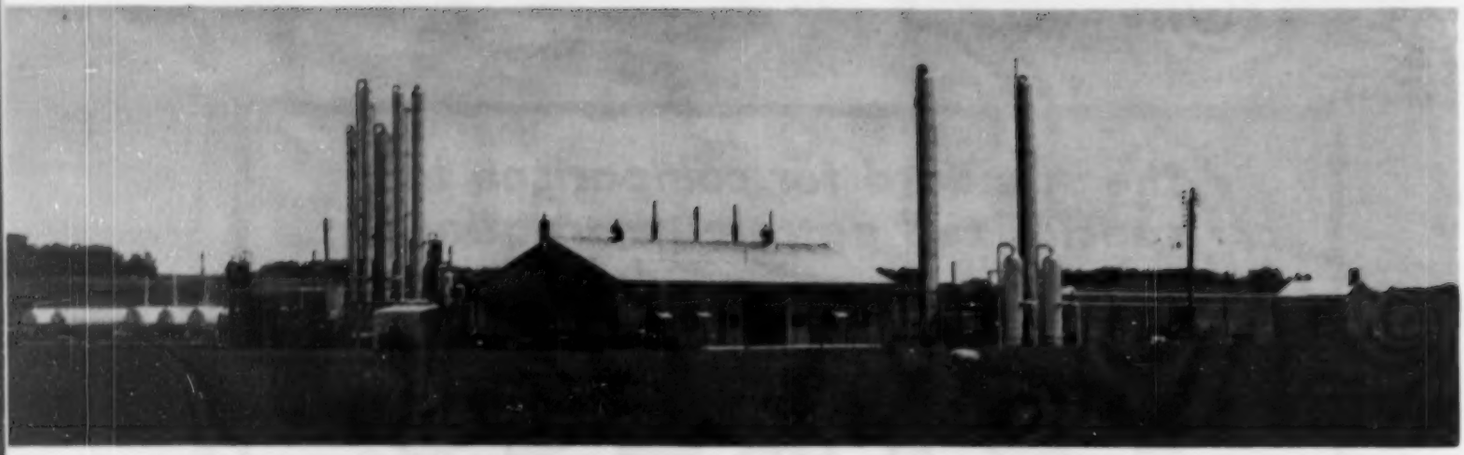
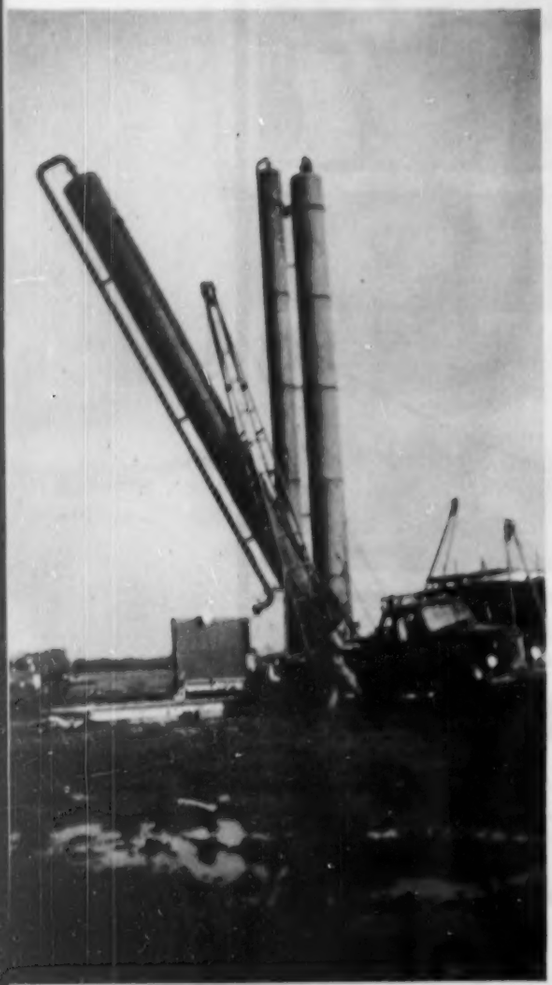


Big Valley: Partial view of plant prior to housing of process units. In foreground is the compressor station. At right the desulfurization plant; left, absorption, distillation and fractionating plant. Storage tanks are in left background.

Packaged absorption plants

Acheson: Erection of still and fractionators.



By G. A. Van Wielingen*

CANADA'S FIRST packaged gas absorption plants are now on full production in two Alberta oil fields. They were built and are operated by Progas of Canada, Inc. through its subsidiary, Progas Ltd., with headquarters at Calgary, Alberta. Plant No. 1 is located approximately 132 miles north-northeast of Calgary in the Big Valley oilfield. Plant No. 2 is situated approximately five miles west of the Edmonton city limits, in the Acheson-Stony Plain field.

Design of the plants is based on the development work done by Otha H. Grimes of Tulsa, Okla., a pioneer in the construction and operation of packaged gasoline plants.

Both plants process wet solution gas produced in conjunction with crude oil. By processing not only separator gas, but also heater-treater and tank vapors, a very high degree of conservation is achieved in both localities. The Big Valley unit handles separator and treater gas produced from 42 oilwells in the Big Valley field which is now integrated with the North Big Valley-Fenn fields. The Acheson plant recovers separator gas, treater and stock tank vapors from 110 oilwells in the Acheson-Stony Plain field.

In both cases, product recoveries consist of propane, butanes, and natural gasoline. In addition, residue gas from the Acheson plant is sold to Northwestern Utilities Ltd. for use in the city of Edmonton. A market for Big Valley residue gas is anticipated at a later date and may depend on the development of the gas export situation in the province.

Although differing in processing capacity, both plants are laid out along similar lines and operating procedures are more or less identical. The units have been designed to facilitate easy expansion and/or alterations and can be moved in their entirety to new fields should the present sources of supply become exhausted. They are tailor-made to meet the specifications prevailing at the present locations, but could be efficiently employed in certain other fields with minor or no alterations. The great majority of the equipment is mounted on skids and the bulk of the piping is prefabricated, which keeps field erection time at a minimum and considerably increases the salvage value of the units. Losses through moving of the plants would be largely confined to foundations and gathering system piping. The skid-mounted and pre-fab arrangements, however, permitted appreciable capital savings on foundations, buildings, electrical wiring and such, so that losses through transfer to another location would, on the whole, be rather insignificant. Considering an average field life of 15 to 20 years, the condition of the gathering system may in many cases be such that its re-employment would be undesirable, added to the fact that its book value may be very small after 15 to 20 years of depreciation at a rate of, say, five percent per annum.

The Acheson plant's initial design capacity is for approximately six million cubic feet of wet gas per day and handling of between 18 to 22 thousand gallons of

*Vice President & General Manager, Progas Limited, Calgary, Alberta.

G. A. Van Wielingen joined Standard-Vacuum Oil Co. in 1947 after four years of army service in Europe, Asia and the Pacific. He worked as an engineer supervising the gas and meter department in Stanvac's South-Sumatra oil fields until 1951, when he joined Gulf Oil Corp. as production engineer in Calgary, Alberta. In November 1952 he was appointed vice president and general manager of Progas Ltd., a subsidiary of Progas of Canada Inc., a manufacturer and distributor of LPGas throughout Western Canada.

operating in ALBERTA

light liquid hydrocarbon over each 24-hour period. Under present oilfield production allowables, approximately 3.5 to 4.0 mmcf. of wet gas are processed, yielding from 16 to 19 thousand gallons of propane, butanes and gasoline per day and plus or minus 2.0 mmcf. of salable residue gas after shrinkage and plant fuel use.

The Big Valley installation's initial design capacity is for approximately two million cubic feet of wet gas per day, and processing of 8 to 10 thousand gallons of light liquid hydrocarbons over each 24-hour period. Under present oilfield production allowables, approximately 1.2 to 1.5 mmcf. of wet gas are being processed, yielding about 6 to 7 thousand gallons of propane, butanes and gasoline per day.

Both plants are subdivided into the following sections:

(1) Gathering system.

(2) Inlet scrubbers and metering station.

(3) Desulfurization unit.

(4) Compressor plant.

(5) Absorption, distillation and fractionating unit.

(6) Product storage and loading facilities.

(7) Dehydration unit.

In addition, a dehydration unit and an air-mixing plant (the latter built and owned by Northwestern Utilities Ltd.) are being operated at Acheson for conditioning of the fuel and residue gas, viz. water vapor removal and lowering of the gas heating value.

Following is a condensed description of the process flow and equipment.

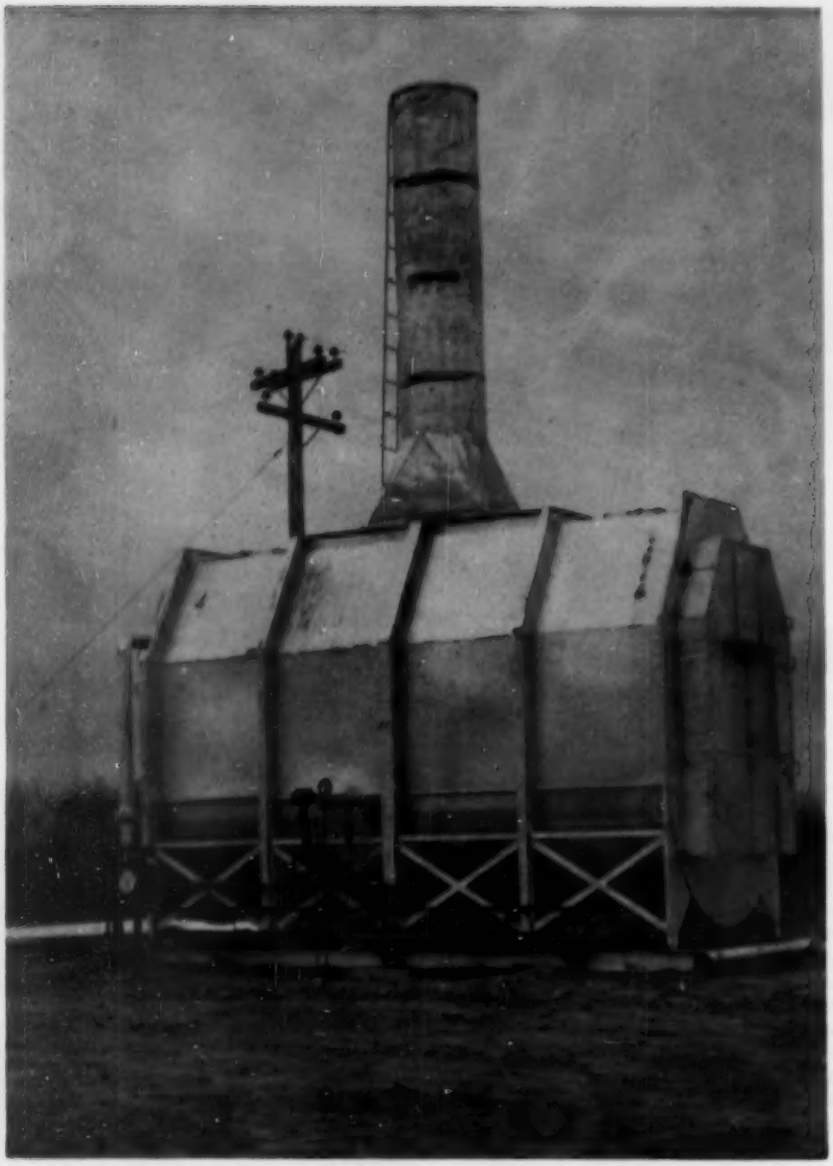
(1) Gathering system: At Acheson, approximately 17 miles of gathering lines are employed to collect separator gas, heater-treater vapors and tank vapors from 16 tank batteries. Nearly 50 percent of this mileage consists of vacuum lines carrying stock tank and heater-treater vapors to the plant. The vacuum lines are paralleled by an equivalent length of low pressure lines through which separator gas flows to the plant. Since field separator pressures are maintained at 70-80 psig, the separator oil then being flashed directly into the stock tanks, the yield of rich tank vapors is significant and their recovery economical. Specially designed regulators maintain an upstream pressure on the tanks of approximately 1.25 ounces above atmospheric, while downstream from the regulators a vacuum of three to four inches of mercury is provided. In this manner, undesirable drawing of air through tank thief hatches and connections can be avoided. Most tank batteries consist of four to eight tanks and, in order to prevent excessive losses of vapors to the atmosphere during tank gauging, automatic shut-offs are provided on each tank, disconnecting it from the collecting system every time a thief hatch is being opened. Every battery of tanks is equipped with a relief valve set at two ounces above atmospheric pressure to facilitate tank vapor release in case of plant shutdowns or regulator failure. Manometers at every battery indicate to the pipe line attendant at a glance whether tank pressures are within the proper range, viz. approximately 1.25 ounces above atmospheric.

The vapors enter the plant through a scrubber and a master orifice meter at a vacuum of nine inches of mercury. They are then compressed to 30 psig and commingled with the separator gas entering the plant from the field.

(2) Inlet Scrubbers and Metering Station: The commingled gas stream now passes through a second scrubber and mist extractor prior to being metered through the plant master meter. Both the vacuum and low-pressure scrubbers are equipped with Joe-Bells with automatically short-circuit the compressor engine ignition system, thus stopping the compressor immediately in case of sudden influx of crude oil or other undesirable liquids that could cause damage to the equipment. Simultaneously a warning signal is sounded and a red warning light will be turned on automatically. Both signal horn and light can only be shut off (manually) after the influx of liquids has been eliminated by the operator.

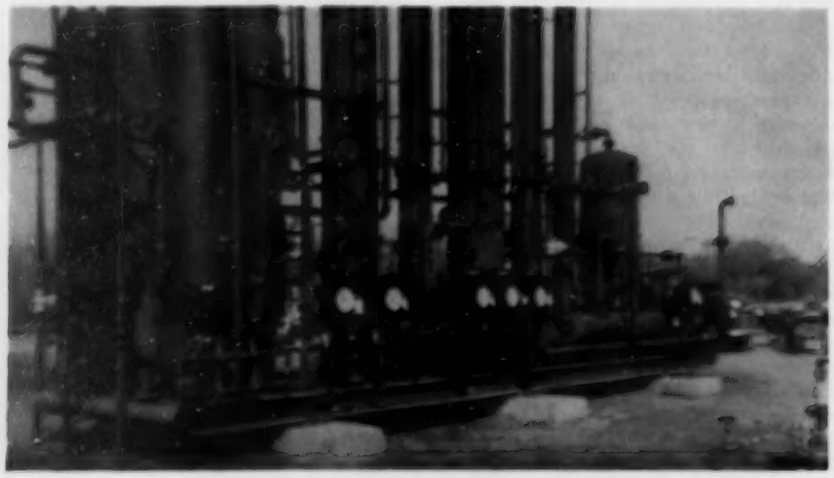
(3) Desulfurization Unit: After passing through the plant master meter, the (sour) 30 psi gas enters the contactor tower of the desulfurization unit where it is stripped of carbon dioxide and hydrogen sulfide by circulating a 15 percent monoethanolamine solution over the top of the contactor which is packed with 2-inch carbon rings providing necessary gas and solution contact. The purified sweet gas leaves the contactor at the top, while the foul solution flows to the regenerator (still) column, where it is stripped of its acid gases at a pressure of three to four psig and a reboiler temperature of approximately 240°F.

Stripping steam is provided by a low pressure, gas-fired boiler operated at 13



Acheson: Rich-oil heater to preheat rich absorption oil stream prior to distillation. The skid-mounted heater weighs 135,000 pounds and has a total heat absorption capacity of 10.5 million Btu per hour.

Big Valley: Partial view of process unit mounted on skid prior to installation.



to 14 psig with steam condensate being returned to the boiler for regeneration. Only small amounts of make-up water are required here. The stripped, lean, monoethanolamine solution is now being recirculated from the still to the top of the contactor, while the acid gases leave the still overhead. The still top temperature is controlled through overhead water reflux by means of a small pump taking suction from the reflux accumulator which receives the condensed water fractions from the acid gases after they have passed through a gas cooler prior to being vented to the atmosphere.

All vessels, pumps, coolers and heat exchangers comprising this unit are accessibly mounted on a 32 by 8 foot steel skid. Room is provided on the skid to permit the installation of a second contactor tower, circulating pump and additional heat exchangers for possible future purification of high-pressure gas from thus far untapped gas-bearing formations in the field.

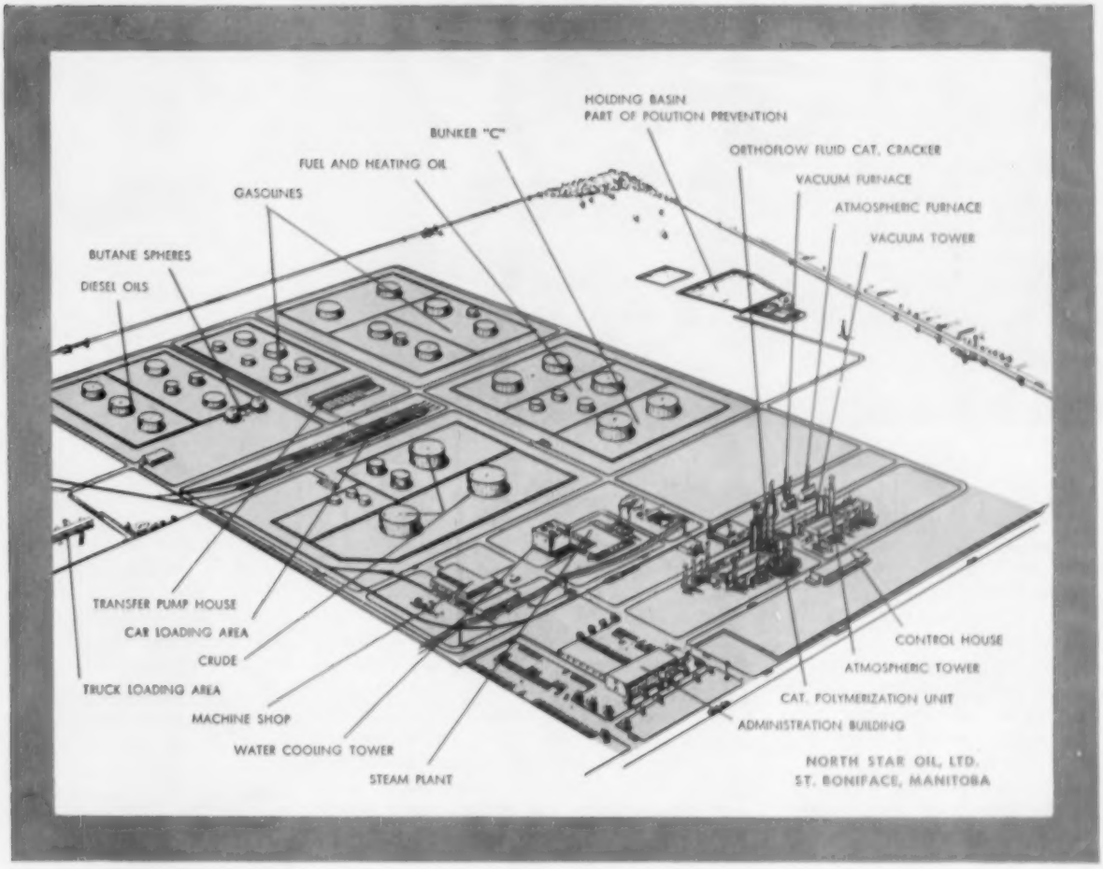
(4) Compressor Plant: After leaving the desulfurization unit, the sweet gas enters the second stage of the compressors at 30 psig and enters the third stage after intercooling at 95 psig. Discharge from the third compression stage takes place at 250 psig, at which pressure the gas enters the lean oil absorber.

The compressor plant presently has an installed potential of 770 bhp delivered by two (440 and 330 bhp) Ingersoll-Rand 4-cycle gas engine-driven compressor units. Both units are self-contained and completely skid-mounted including gas inlet and intermediate scrubbers, lube oil coolers and radiators for engine and compressor jacket water cooling and gas interstage cooling.

Engine speed is automatically governed by a volume load adjustment, instrument control, thus assuring maximum fuel efficiency and preventing excessive engine wear.

(5) Absorption, Distillation and Fractionating Unit: The cooled 250 psig gas stream now enters the absorber after passing through a high stage scrubber. In the absorber, the wet gas is stripped of its liquid components through intimate contact with lean (diesel) oil by bubbling through a series of trays filled with lean oil. The stripped gas then leaves via the top of the absorber and flows to the dehydration unit after passing through a residue gas scrubber.

The saturated rich oil solution leaves the absorber bottom to enter the lower compartment of the hot oil flash tank. The function of this vessel is to further remove methane and ethane components contained in the rich oil solution. These



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Acheson: Skid-mounted process heat exchanger unit prior to installation.

vapors are returned to the upper section of the absorber bottom where they pass through a demethanizing section and then combine again with the incoming wet gas.

The flashed oil leaves the lower compartment of the hot oil flash tank and enters the upper compartment. A centrifugal pump taking suction from the bottom of the upper compartment then transfers the rich oil to the rich oil heater to be heated to 500°F. Before entering the heater, a side stream of the rich oil is utilized as a heat exchanging medium (350°F) for the fractionating reboilers and steam evaporator reboiler after which it is returned to the rich oil heater. The 500°F rich oil solution leaving the heater then enters again the upper compartment of the hot oil flash tank at a point approximately halfway between the top and bottom of this vessel. There it commingles with the rich oil stream entering from the lower compartment and leaves the vessel over the top to enter the still at approximately 470°. There the rich oil solution is stripped of its hydrocarbon vapors which leave the still over the top at a temperature of 210°F. The 120 psi steam generated by the steam evaporator is injected into the still for stripping agitation. The operating pressure of the still is 115 psig. The steam condensed in the upper section of the still is recovered by means of a water leg from whence the steam condensate is returned to the evaporator for regeneration. The stripped, lean absorption oil accumulates at the still bottom from where it is recirculated to the absorber top after passing through a series of heat exchangers and coolers.

The hydrocarbon vapors, after leaving the still overhead, pass through a cooler into the make accumulator where they are condensed to liquid form. This liquid is then transferred into a horizontal raw feed surge tank. A centrifugal pump taking suction on the bottom of the upper compartment of the make accumulator supplies the still overhead reflux for temperature control of the still top after first passing the reflux raw feed through the lower compartment of the make accumulator. Here condensation of water vapors takes place and the water is automatically drained from the bottom of the lower compartment to be returned to the evaporator.

A gas-driven reciprocating pump taking suction from the bottom of the raw feed surge tank charges the raw feed to the depropanizer column, where propane and ethane leave the column overhead and a stream of butanes and heavier components leaves the column via the bottom. The propane and ethane stream, after cooling and condensation, enters the de-ethanizer column where the finished and water-free propane liquid product leaves at the bottom and flows to the storage tanks after passing through a series of coolers and exchangers; the ethane overhead stream is combined with the residue gas stream after passing through a cooler and reflux accumulator for further utilization as a fuel gas.

The butane-and-heavier stream leaving the bottom of the de-propanizer is charged to the de-butanizer column. Here the stream is split, butane vapors leaving the column over the top, pentanes and heavier components leaving the column through the bottom, flowing to the storage tanks after passing through a heat exchanger and a skid-mounted doctor-sweetening unit for mercaptan removal. The overhead butane vapors are cooled and condensed prior to entering the storage tanks as a finished liquid product.

Reflux for top temperature control of all three fractionators is obtained from the condensed overhead stream of the respective column and circulated by means of gas-driven reciprocating pumps. The same type of pump is employed for charging the de-propanizer and de-ethanizer columns, while the de-butanizer charge is moved through the pressure differential existing between the de-propanizer and de-butanizer columns.

An effective and ingeniously arranged system of coolers and heat exchangers provides ultimate application of heating and cooling throughout the entire process, thus greatly contributing to fuel saving and plant efficiency.

The gas-powered reciprocating pumps mentioned above are driven by means of a 250 psig residue gas stream. The pressure drop involved is 220 psig across the power end of the pumps and the 30 psig discharge stream then enters the plant fuel system to be used further as engine, boiler and heater fuel.

Prior to entering the de-propanizer column, the raw feed passes through a caustic wash unit for removal of any traces of sulfur that may be present in the liquid.

The absorber, still, evaporator, the three fractionators, the hot-oil flash tanks, field and residue gas scrubbers, make accumulator, reflux accumulators, three reboilers, control instruments and regulators are all conveniently mounted on an 8 by 32 foot steel skid. Several of the scrubbers and accumulators are combined in multi-compartment vessels in order to save space. Two of the centrifugal pumps are also mounted on the skid, while a third one and the lean oil circulating pump are mounted on separate small skids adjacent to the unit. The five reciprocating pumps are also skid-mounted and accessibly placed near the unit.

All heat exchangers and coolers are mounted on two smaller skids, which are placed close to the unit.

The process cooling water tower consists of a concrete basin and prefabricated three-cell redwood structure, featuring three reversible, two-speed fans, one on top of each cell. A 25-hp centrifugal pump takes suction from the tower basin and distributes the cooling water over the unit. The return-water stream enters the top of the cooling tower from opposite directions, for cooling and recirculation. Make-up water for process and engine

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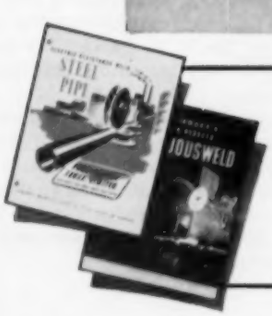

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TABLE I

PRODUCTION AND SALES OF LPGAS IN ALBERTA

(Millions of Gallons)

Year	Production		Import Propane	Sales*	
	Propane	Butanes		Propane	Butanes
1948	0.4	...	Not Available	Not Available	..
1949	2.3	...	Not Available	Not Available	..
1950	5.9	1.4	Not Available	5.4	1.3
1951	10.4	3.5	Not Available	9.9	1.1
1952	14.2	6.0	0.2	14.2	3.3
1953	18.2	8.3	0.5	18.6	4.1
1954	22.2	10.0	1.0	22.0	8.6

*Export of propane estimated at 4 to 7% of total sales.
Export of butanes estimated at 20 to 25% of total sales.
(Source: Alberta Petroleum & Natural Gas Conservation Board)

cooling, etc., is drawn from two water-wells at the plant site.

(6) Products Storage and Loading Facilities: Propane storage consists of one 300,000- and two 12,000-gallon horizontal tanks. Five horizontal tanks provide storage for 36,000 gallons of butane and 24,000 gallons for natural gasoline. Truck loading facilities at the present time consist of a 5-hp centrifugal LPGas pump and two loading risers, one for LPGas, the other for gasoline. Installation of additional risers, meters and pumps is contemplated for the near future.

A temporary tank-car loading installation is operated at a site adjacent to the C.N.R. track approximately one mile from the plant. Liquids are trucked from the plant to the railway site at present, but consideration is being given to the eventual construction of a products pipe line from the plant to the site.

(7) Dehydration Unit: The lean residue gas, after leaving the absorption unit, enters the dehydration plant for water vapor removal in order to meet utility specifications. It first enters a knockout scrubber for free water removal, after which the gas enters the glycol absorption tower where is is stripped of its water vapor content by a triethylene glycol stream. The dry gas is then measured through an orifice meter from which it enters the system of the utility company.

The water loaded glycol solution is returned to a gas-fired regenerator unit and water is boiled off by maintaining a temperature of 375°F on the regenerator vessel. The lean solution then is recirculated to the absorber tower.

The compact nature of the plant, together with its far-reaching automatic control features, makes it possible to keep attendance to a minimum. One operator for each 8-hour shift can adequately attend to the units, as his duties mainly consist of product testing, servicing of pumps, engines and other equipment, recording of data, product gauging and dispatching of trucks. In addition, a pipe line attendant divides his time between supervision of the gathering system and miscellaneous labor at the plant proper during daytime hours. A plant foreman, living in a company house on the site, is in charge of the operation and performs also the duties of a plant mechanic.

All sections of the plant are properly housed for weather protection, while vessels and piping are insulated wherever necessary. During the past winter months, with minimum temperatures from +20°F to —30° F, no difficulties were experienced apart from a few very minor freeze-ups, mostly at exposed drainage points, and no downtime occurred during the entire winter season. The addition of 10 to 15 gallons per day of methyl alcohol to the gathering system was generally adequate to prevent freeze-ups at regulators and in the pipe lines.

The design construction and process flow at the plant is essentially similar to that of the Acheson plant, with the following exceptions:

The gathering system consists of two parallel trunk lines each approximately 500 feet long. All gas is gathered from one central tank battery with the plant being located adjacent to the battery lease.

Compressor equipment consists of one skid-mounted Type X Ingersoll-Rand compressor belt-driven by a gas powered 50-hp Waukesha engine, for boosting heater-treater vapors from three to 35 psig.

Two skid-mounted, self-contained, radiator cooled Chicago Pneumatic two-stage compressor units are belt-driven by gas-powered 146-hp Waukesha engines for compressing the purified gas from approximately 30 to 250 psig, which is the absorber intake pressure.

Product storage consists of three 12,000-gallon tanks for propane, two 7,200-gallon tanks for butanes and two 6,000-gallon tanks for natural gasoline.

The capacities of most of the process equipment ranges from about one-half to one-third of that at the Acheson plant installation.

Make-up water for process and engine cooling is obtained from three wells at the site.

The marketing division of Stewart Petroleum Ltd., an affiliated company operating as bulk marketers, distributors and retailers of liquefied gases and appliances throughout Alberta, parts of Saskatchewan and outlets in the Yukon, the Northwest Territories and Alaska, handles the entire output of LPGas and natural gasoline from the Progas plants in addition to their other sources of supply.

Considerable progress has been made by the LPGas industry in Alberta during the past four or five years, as can be seen by Table I.

Increasing LPGas production and sales are expected to create an increasing number of problems for both manufacturers and marketers, requiring constant reorientation, alertness and sound economic thinking. Manufacturers begin to realize that through the more or less sudden influx of large volumes of products from additional plants, a delicate situation may arise with regard to the gradual, but somewhat slower, absorption of products by the market. Distributors are faced with a high mileage cost per delivered gallon due to the low density of population and trying road conditions in many parts of the country, especially during winter and spring and break-up seasons. The situation here is somewhat similar to that in the U. S. mountain states like Montana, Idaho and Wyoming. Generally speaking, it should be borne in mind that the Western Canadian LPGas industry is less than 10 years old, as compared with the U. S. industry, which is some 30 years old. It is expected, however, that Western Canadian industrial expansion will take place at a more rapid rate than was the case in the U. S., largely because U. S. past experience is a guiding factor to local industry.

Concerted efforts are being made to develop new uses for LPGas such as gasoline engine conversions, farm applications, road construction and chemical uses —all fields that have barely been exploited, partly due to the fact that (a) sufficient quantities of product were not available until recently to assure constant supply to the potential customer, and (b) educational programs stressing the usefulness and efficiency of LPGas for the above applications were lacking.

The hitherto unfavorable consumption ratio in Western Canada of LPGas between the summer and winter months is expected to be levelled out to a more favorable proportion through utilization of underground storage in Alberta and progress expected to be made by increasing summer usage as outlined above. In addition to this, it is anticipated that considerable gallonage may be exported from Alberta to the U. S. Pacific Northwest states, where an increasing shortage of supply exists.

In conclusion, it might be said that the future of the Western Canadian LPGas industry, now in its infancy, would appear to be encouraging, owing to the fact that new uses and markets have been and are being found for these products continuously.

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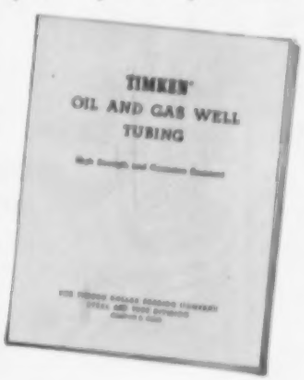

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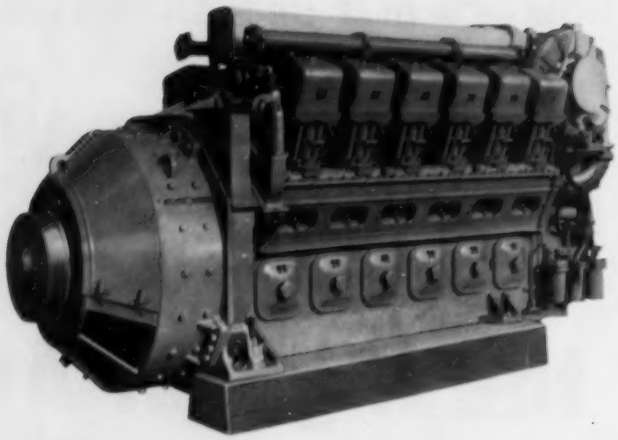

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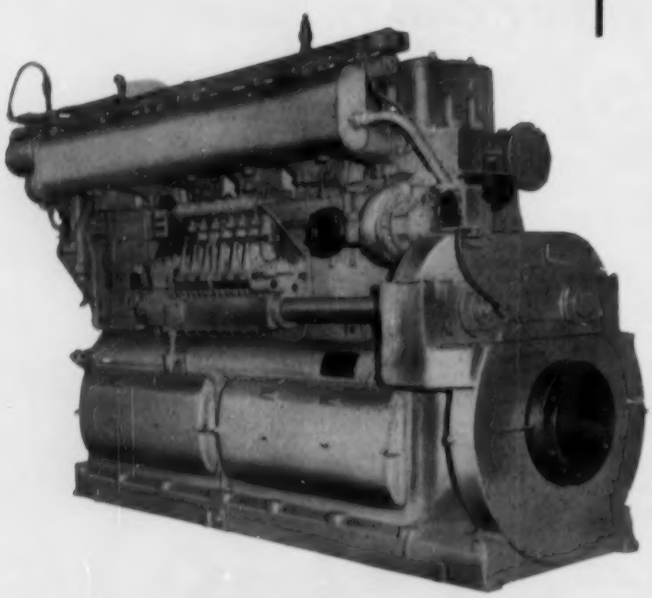

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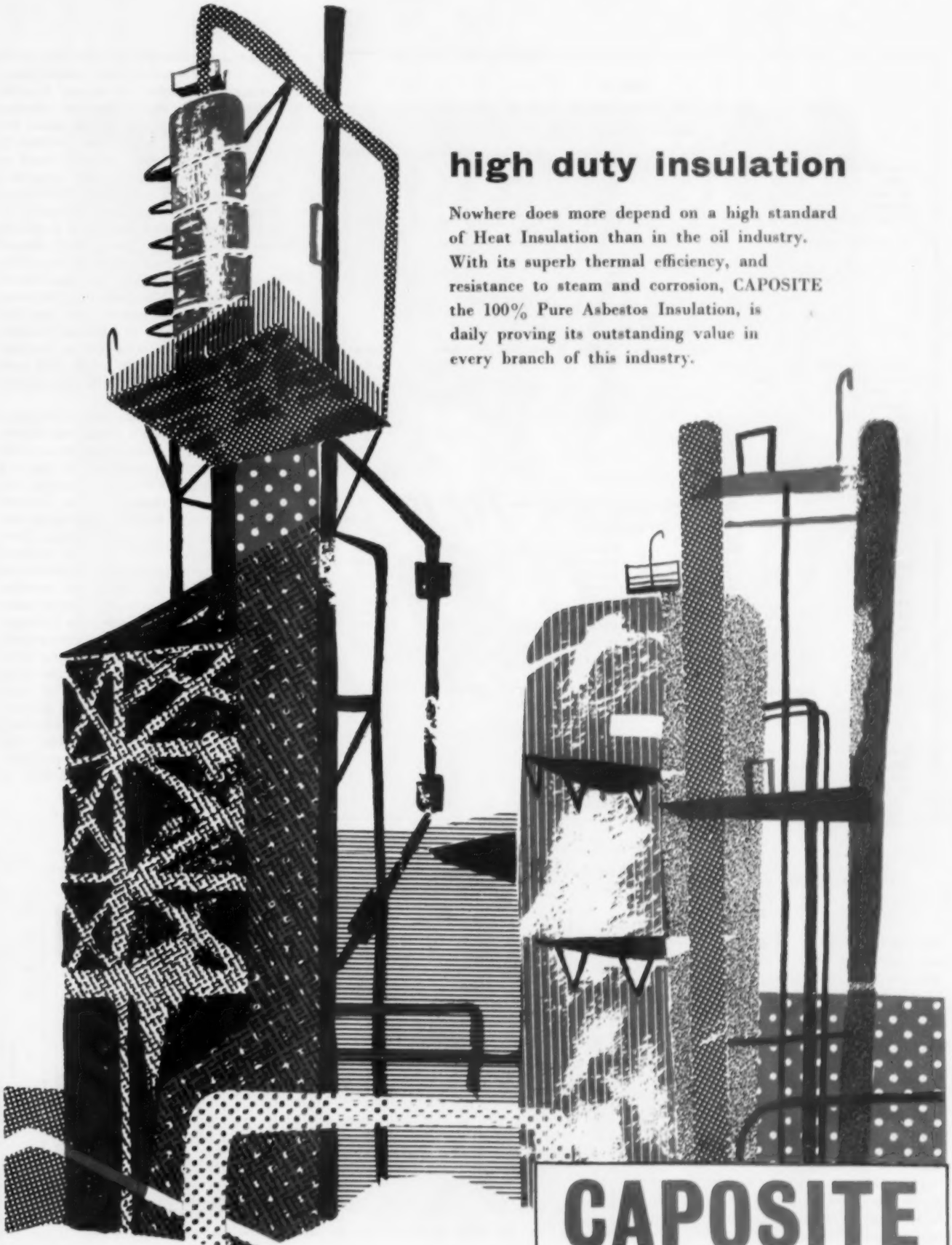

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TABLE I

REGIONAL BREAKDOWN OF CONSUMPTION

(Thousands of Barrels Daily)

	West Coast	Prairies	Ont./Que.	Atlantic	Canada
Aviation Gasoline	1	2	2	2	7
Motor Gasoline	18	52	109	14	193
Middle Distillates	18	25	105	16	164
Residual	18	23	53	14	108
Other Products	4	20	56	4	84
Crude and Products	59	122	325	50	556

TABLE II

CHANGE IN 1954 CONSUMPTION BY AREAS

(Percentage of Increase or Decrease)

	West Coast	Prairies	Ont./Que.	Atlantic	Canada
Aviation Gasoline	—15	4	—6	—13	—7
Motor Gasoline	5	—2	6	9	4
Middle Distillates	17	25	21	14	21
Residual	—1	—8	6	7	1
Other Products	5	4	11	9	9
Crude and Products	7	3	11	10	9

TABLE III

CANADIAN REFINERY CAPACITY BY AREAS

(Barrels Daily)

	West Coast	Prairies	Eastern Canada	Canada
1949	28,850	77,975	230,000	336,825
1950	28,850	89,525	240,500	358,875
1951	28,850	120,700	261,700	411,250
1952	29,850	130,450	288,100	448,400
1953	45,850	150,100	338,800	534,750
1954	53,500	162,600	350,300	566,400

TABLE IV

COMPARISON OF REFINERY CAPACITY AND RUNS WITH DEMAND

(Thousands of Barrels Daily)

	West Coast	Prairies	Ont./Que.	Atlantic	Canada
Demand	59	122	325	50	556
Runs	41	122	285	17	465
Capacity	50	156	326	18	550
% Spare Capacity	18	22	13	6	15

power to jet aircraft, but also as a result of poor flying weather which caused many international flights to bypass Gander, Newfoundland. Motor gasoline demand increased substantially in all areas except the Prairies, where wet weather in the spring and summer reduced work on the large grain farms and caused a marked drop in the harvest. The return of normal winter weather, entailing increases of 10 percent and more in degree days in many areas, was a basic cause of the extremely high growth in middle distillate requirements. Installation of nearly 140,000 oil-burners, only fractionally below the 1953 record level, was also a major contributor. In addition, continuation of the railway dieselization program and the military shift to jet aircraft were other important factors in the 21 percent increase.

Export grain markets were materially reduced in 1954. As a result, rail movements of grain were substantially smaller, causing a sharp reduction in railway bunker fuel requirements. Likewise, the reduction in international trade lowered ships' fuel requirements, depressing demand levels in the coastal areas. Continued industrial conversion to residual fuel, and increased heating requirements for commercial and industrial installations, were sufficient to offset these losses and yield an increase somewhat in excess of one percent, with the significant growth in Eastern Canada counterbalancing losses in the West. The demand for the more specialized products, comprised of such products as lubricating oils and greases, coke, asphalt, and liquefied petroleum gases, increased in all areas when considered as a composite, despite some reductions in lubricating oil markets in particular.

(Continued on page 124)

Canadian Oil — 1954

(Continued from page 54)

try emerges: Canada, with existing refining techniques, must import substantial volumes of light fuel oils in order to balance demand. Residual fuel requirements likewise exceed the volumes which may readily and economically be produced, resulting in a continued import of this product. The Prairies are the one area which can be supplied entirely from domestic refineries, due to the relatively high gasoline requirements for agriculture, and the restraining influence on heating oil demand of local supplies of both coal and natural gas.

The pattern of change which yielded these 1954 demands is indicated in Table II showing the percentage change in various demands during 1954. A brief examination of these percentages shows the influence which weather had on 1954 results. Aviation gasoline demand declined in part due to the shift of military air-

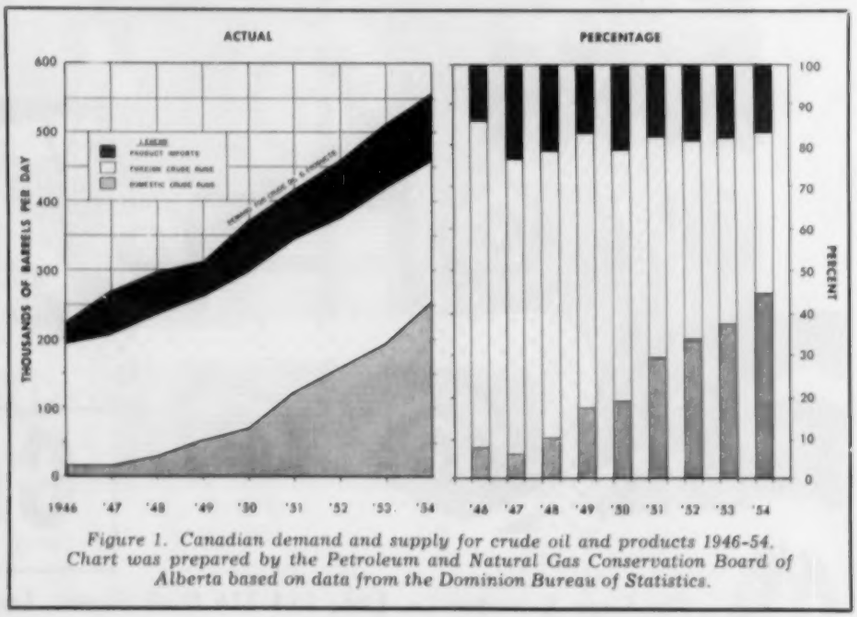

Figure 1. Canadian demand and supply for crude oil and products 1946-54. Chart was prepared by the Petroleum and Natural Gas Conservation Board of Alberta based on data from the Dominion Bureau of Statistics.

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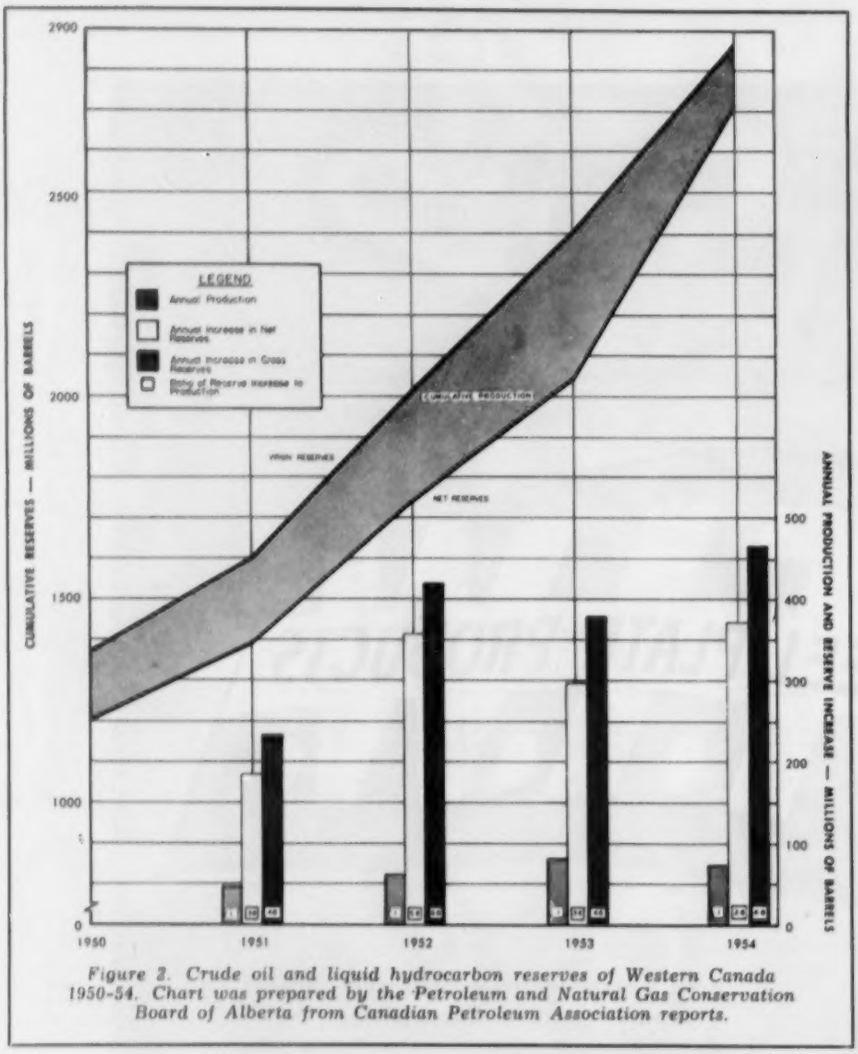


Figure 2. Crude oil and liquid hydrocarbon reserves of Western Canada 1950-54. Chart was prepared by the Petroleum and Natural Gas Conservation Board of Alberta from Canadian Petroleum Association reports.

Canadian Oil — 1954

(Continued from page 122)

These varied results combined to yield the nine percent increase in domestic crude and products demand mentioned above. Markets in Eastern Canada were up by 10-12 percent, while British Columbia demand increased more than seven percent despite reductions in railway and ships' fuel requirements. The cumulative effect of depressed gasoline and residual demand in the Prairies resulting from wet weather and smaller grain markets was sufficiently offset by sharp middle distillate growth to yield an overall increase of nearly three percent.

Meeting these greatly enlarged demands in the post-war period has entailed a continued expansion in the industry's supply facilities. A great deal has already been written about the progress that has been made in finding and producing crude oil in this country in the last seven years. Prior to the major discoveries in 1947 and 1948, Canada was producing about 20,000 barrels daily of crude oil, or about 10 percent of its domestic demand. By 1954 production had risen to 263,000 barrels daily, and was nearly half as large as the greatly expanded domestic requirements. In 1954 alone there was a 20 percent increase in production.

Eight years ago, small volumes of domestic crude oil were moving from local fields to adjacent refineries in the Prairies and Ontario. The balance of refinery requirements were supplied from crude imports to all areas, with product imports supplying the remaining deficiencies. Today, as a result of two major pipe lines, the country's greatly enlarged refinery capacity from Ontario to British Columbia is supplied entirely by domestic crude oil, with minor exceptions in the Duluth/Superior area at the head of the Great Lakes and the only presently operating major refinery in the Pacific Northwest. Two important pipe line developments late in 1953 have made these achievements possible. First, there was the completion of the Trans Mountain Pipe Line from Alberta to Vancouver and adjacent areas in Washington, which provided the first major supplies of Canadian crude oil to this area, supplanting previous imports from California. Secondly, the Interprovincial Pipe Line system was extended to Sarnia, Ontario, providing year-round supplies of crude oil to this major refining centre. This virtually eliminated crude oil imports from the Illinois/Mid-Continent area into Ontario. The expanding area of influence in domestic crude markets, the new export outlet in Washington, and the growth in markets previously supplied, stimulated the 20 percent increase in 1954 production.

This average experience during the year does not tell the whole story of 1954 crude production. For example, the 35,000 b/d General Petroleum refinery at Ferndale, Washington, did not come on stream until late in the year. In addition, there was a general improvement in petroleum markets in the fourth quarter. As a result, crude production in the last few weeks of the year exceeded 300,000 b/d. Completion of Shell's 50,000 b/d plant on Anacortes Island in Washington and Great Northern's 25,000 b/d refinery in Minneapolis should provide some additional export market in 1955. The latter is particularly significant as it will be an outlet for Saskatchewan medium gravity crude which has previously been restricted by quality problems. This outlet has entailed the construction of a 155-mile pipe line from the Fosterton area of Saskatchewan to the Interprovincial system at Regina, and a second line from Interprovincial at Clearbrook, Minnesota 260 miles to Minneapolis. These developments imply an-

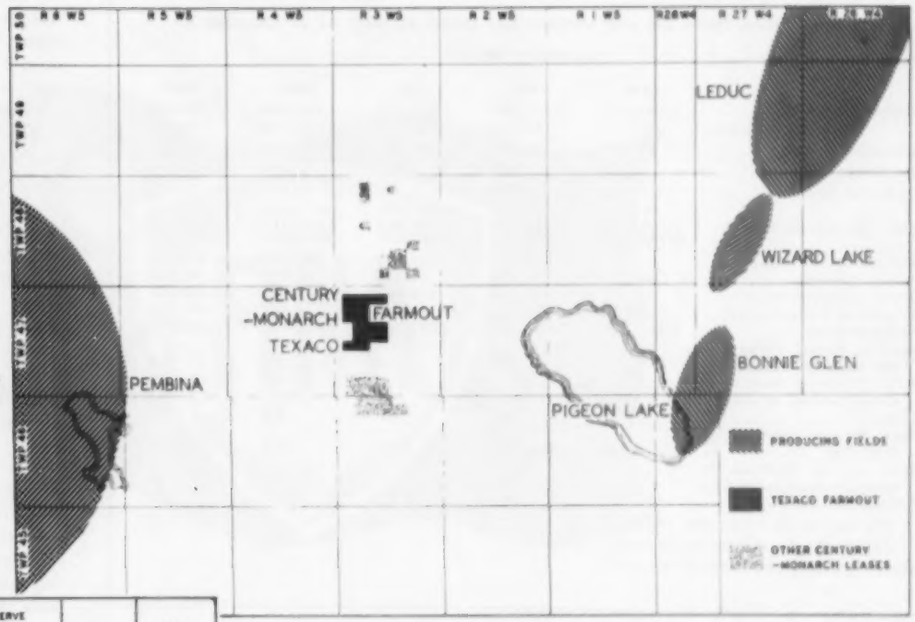
(Continued on page 126)

TABLE V

ANALYSIS OF PETROLEUM AND PRODUCTS SUPPLY

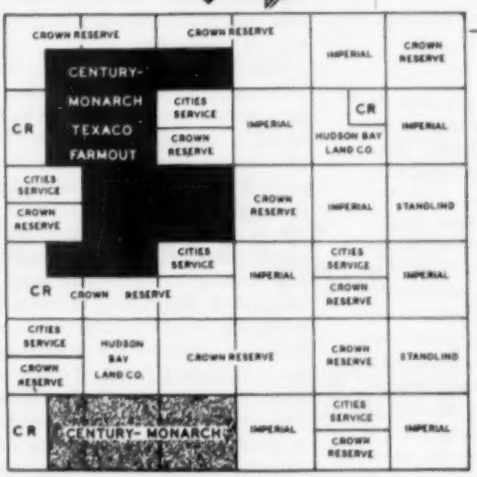
(Thousands of Barrels Daily)

	Domestic Production	Crude Imports	Product Imports	New Supply
1949	59	207	52	318
1950	80	220	80	380
1951	132	231	82	445
1952	170	225	93	488
1953	225	223	97	545
1954	267	210	97	574



Right:
Map of general area showing location of Century-Monarch farmout to Texaco Exploration Co.

Below:
Map of Twp. 47, Range 3 W5 showing ownership of acreage adjacent to Texaco farmout.



TO TEST ALBERTA ACREAGE

Century Oils Limited and Monarch Oils Limited have arranged to test five and a half sections of their 14-section West Pigeon Lake lease within the next few months under a farmout agreement recently signed with Texaco Exploration Company. Under terms of the agreement, Texaco will earn a half interest in the lease by drilling a test to the Madison or to 6,300 feet unless commercial production is encountered at a shallower depth.

The Century-Monarch West Pigeon Lake lease is roughly half way between the Pembina field to the west and the Leduc, Wizard Lake and Pigeon Lake field to the east, where Texaco recently made a new Cardium discovery. The Cardium discovery at Pigeon Lake was one of several in areas outside the previously recognized limits of Pembina.

Development is continuing in the Woodnorth field in Manitoba in which Century now has an interest in seven producing wells. An eighth location has been staked.

Scope and Acheson development work has been suspended after gas discoveries pending availability of pipe line outlet.

Century and Monarch have reduced all reservations in Western Canada to firm leases preparatory to future development drilling.

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OILS LIMITED
601, Leeson-Lineham Building,
Calgary, Alberta

TABLE VI

WESTERN CANADA CRUDE OIL AND NATURAL GAS LIQUID RESERVES AS AT DECEMBER 31

(Thousands of Barrels)

	1950	1951	1952	1953	1954
Alberta: Crude Oil	1,165,000	1,328,000	1,526,389	1,624,496	1,928,479
Natural Gas Liquids	(*)	11,000	65,374	198,126	208,331
Saskatchewan	10,300	21,000	124,247	182,159	222,365
Manitoba	.....	500	2,106	10,890	29,127
Northwest Territories	27,300	27,100	26,767	26,442	16,172
Total Western Canada	1,202,600	1,387,600	1,744,883	2,042,113	2,415,945
Net Increase in Reserves	.....	185,000	357,283	297,230	372,397
Annual Production (†)	28,996	48,249	62,083	81,815	97,064
Gross Increase in Reserves	.....	233,249	419,366	379,045	469,461
Cumulative Production (†)	162,677	210,926	273,009	354,824	451,888
Virgin Reserves	1,365,277	1,598,526	2,017,892	2,396,937	2,867,833
Ratio of Annual Increase in Net Reserves to Production	....	3.8	5.8	3.6	3.8
Ratio of Annual Increase in Gross Reserves to Production	....	4.8	6.8	4.6	4.8
Ratio of Net Reserves to Production	41.5	28.8	28.1	25.0	24.2
Ratio of Net Reserves to Total Canadian Demand for Crude Oil and Products	8.8	9.1	10.3	10.9	....

(*) Not reported December 1950.

(†) Crude oil and natural gas liquids.

Source: The Canadian Petroleum Association.

Canadian Oil — 1954

(Continued from page 124)

other record year for Canadian crude production in 1955.

Concurrent with the growth in crude production and the extension of crude distribution facilities, there has been a general expansion in refining facilities. Table III, showing year-end refinery capacities, gives the rate and location of increases in refinery capacities in barrels daily. As a result of new pipe line facilities, all British Columbia refineries have been expanded since late 1953, or are now being expanded. In addition, one new refinery has been built in the area. Similarly, improved crude supplies for Ontario have led to a new refinery and expansion of other plants in this region. Expansion and new construction has followed the introduction of crude pipe lines in all areas. In the Prairies, which were first to get domestic crude in quantity, the most marked expansion has occurred. Programs now under way indicate continued new construction in all areas.

During 1954, these refineries ran nearly 465,000 b/d of crude, or almost 85 percent of the average capacity for the year. The products produced from these operations in turn supplied about 85 percent of crude and product demand. Table IV shows crude and product demand, crude runs, average refinery capacities, and spare capacity by area. Spare capacity exists in all areas, with the proportion somewhat higher in the West, where normal summer weather with higher gasoline requirements would have reduced this ratio appreciably. However, this level of operations provided all of the gasoline required by the Canadian market, except for minor volumes in the Atlantic provinces where a major refinery expansion program is now under way.

The cumulative effect of these supply developments has been a reduction of 13,000 barrels daily in crude and product imports, the first significant reduction in the post-war period. This is illustrated by Table V, which includes other liquid production with crude oil and contrasts this volume with crude and product imports and total new supply. It can readily be seen that in the last few years the growth in required petroleum supplies has come from domestic sources. Crude oil imports have been stabilized since 1950. The increases which have occurred in product imports have been almost entirely in fuel oils as a result of the inability to produce all of these products that have been required.

Crude imports are now restricted almost entirely to Quebec and the Atlantic provinces. Some growth in crude imports to this area may be expected as market requirements increase. This growth should be offset, in part, by the reduction or elimination of crude imports to Ontario. Product imports may be expected to increase somewhat as demand for middle distillate and residual rises.

This ability of the industry to meet increased requirements from domestic sources has hinged on the success of the exploration and development effort in Western Canada. Between 1946 and 1954, it is estimated that some 1.7 billion dollars had been invested in this effort, and at the end of 1954 the producing industry held nearly 170 million acres of land in Western Canada in reservation for oil prospecting. As a result of this activity, remaining crude oil reserves have been increasing at a rapid and fairly constant rate. Today, remaining proven crude oil and other liquid reserves are over 2.4 billion barrels, more than ten times those at the end of 1947.

The most important of recent discoveries in Western Canada appears to be the Pembina field in Alberta. This field was discovered late in 1953, but due to unfavorable weather, development was delayed until late summer in 1954. At the present time, it is the center of unprecedented development activity in Western Canada. In the past few months important discoveries were made in the Peace River area of Alberta in the form of extensions to the Sturgeon Lake field and the new South Sturgeon Lake field. Recently, interesting discoveries have been made in Southeast Saskatchewan, and although it is too soon to fully assess these discoveries, much interest has been directed toward the area. Recent developments in Western Manitoba in the Roselea area have also been important and indicate that Manitoba too will have substantial oil production.

The factors which have led to the achievements that have been discussed here should again be evident in 1955. Demand is expected to follow the pattern of recent years and exceed the rate of growth experienced in 1954. The transition from inadequate supply facilities to ample crude production, ample and efficient transportation, and ample, modern refining capacity has been virtually completed. Expanding markets will cause increased crude production and higher levels of refinery operations, continuing the established trend of meeting an increasing proportion of requirements from domestic sources. At the same time, larger crude oil imports will be needed for Atlantic seaboard refineries, and greater volumes of imported fuel oils will be required to fill growing heating needs. Further expansion in existing crude export markets should occur with the completion of refineries now under construction.

TABLE VII

CANADIAN SUPPLY AND DEMAND FOR OIL

(Thousands of barrels daily)

	1952	1953	1954
Demand			
Demand	473.1	519.8	565.0
Exports	6.1	7.5	9.0
Domestic Demand	467.0	512.3	556.0
Supply			
Crude Production	167.3	221.6	263.1
Other Production	3.1	3.4	4.0
Crude Imports	225.3	223.0	210.0
Prod. Imports	92.7	96.8	97.1
Total Supply	488.4	544.8	574.2
Inventory			
Stock Changes	+15.3	+25.5	+9.2

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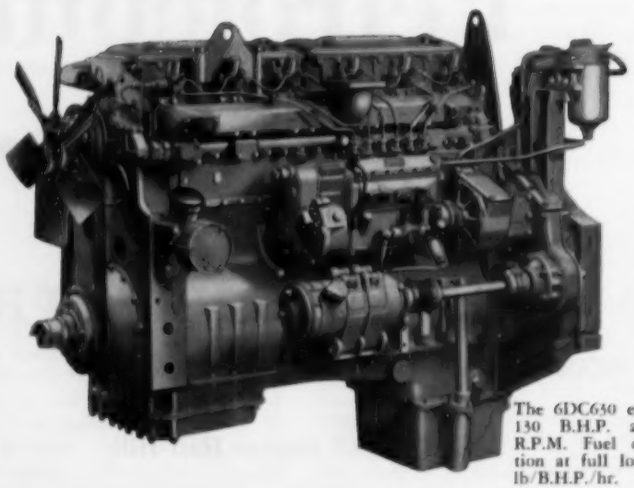

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The reactor and transition piece going on during construction of the catalytic cracking unit of British American Oil's Clarkson, Ont. refinery.

Revision of Bank Act facilitates oil loans

By A. S. de Rosenroll

BANKS IN CANADA—there are eleven of them — operate under the branch bank system and when a charter is granted it carries with it authority to establish branches in every Province without restriction as to numbers. Banking facilities may, therefore, be provided wherever the need becomes apparent and each branch bank is fully equipped to give every banking service.

The only legislative body in Canada with power to legislate in connection with banks and banking is the Federal Parliament. Accordingly, all Canadian banks operate under Federal Charter and are subject to the provisions of and powers granted by the "Bank Act." To keep abreast of the times, the "Bank Act" comes up for revision each decade. The Act then receives a careful overhauling and such changes are made, or fresh powers and provisions are added, as may be found necessary in the light of experience and the changing economy of the country. Among the provisions and powers of the Act there are those relating to securities which banks may take—and may not take—and those powers and provisions are, of course, of interest not only to the oil industry, but to industries in general. One of the provisions of the Act is that banks may not make loans on the security of real or personal property unless specifically authorized in the Act. Among the powers of long standing are those that give banks authority to lend money on the security of products of agriculture, products of the forest, products of the quarry and mine and products of the sea, lakes and rivers. It was not until Royal Assent was given to the present "Bank Act" in June 1954 that provisions and powers were written into the Act specifically to take care of the oil industry.

Before the discovery of oil at Leduc in 1947 and the subsequent discoveries at Redwater and elsewhere in quick succession, the demands of the oil industry upon the banks for financial support were very modest. Financial needs for development of Turner Valley field, which started about 1913, were supplied throughout by risk capital and banks probably then took the same view of the industry as we are told was taken by the banks in Oklahoma in the early days of the industry in that State. However, with Leduc came the realization that this natural resource, oil, would play an increasingly important role in the economy of Canada. Our Canadian bankers were not slow in taking a hard look at the industry and what they saw was good, but we had no bankers with experience in oil business. It was quickly decided to lean upon the experience of those great banks in the United States that played such an important part in the growth of the industry in that country. The banks doing business in Alberta sent members of their staffs on tours to visit United States banks with backgrounds of many years of successful experience in dealing with oil accounts. The American oil bankers were good to our representatives; they showed them many courtesies and we are grateful. Within a short time each of the Canadian banks was actively servicing oil accounts, making production loans and energetically competing for oil business in general.

In the early stages it was realized that our "Bank Act" did not provide sufficiently wide powers to take securities for oil accounts along the lines taken by American banks. The prohibition to make loans on the security of real and personal property ruled out the furnishing of trust deeds directly to the banks covering lands, leases, oil within or under the ground and production equipment. We classified crude oil as one of the "products of the mine" and relied upon that section of the Act that authorized loans on the security of those products and the relative securities with special collateral agreements and undertakings given by the customer. Another method was to create a debenture issue secured by a trust deed in favor of a trust company covering lands, leases, crude oil and equipment and then pledge the debenture to the bank. This method of taking se-

A. S. de Rosenroll, manager of the Imperial Bank of Canada at Calgary, is a native of Western Canada. He joined the staff of the Imperial Bank in 1913, and after serving in a number of Alberta branches, was appointed manager at Ferintosh, Alberta in 1919 and at Moose Jaw, Saskatchewan in 1930. He transferred to Calgary in 1947, just a few months before the important oil discoveries at Leduc and Redwater. Mr. de Rosenroll saw active war service in World War I on the Western Front in 1915.

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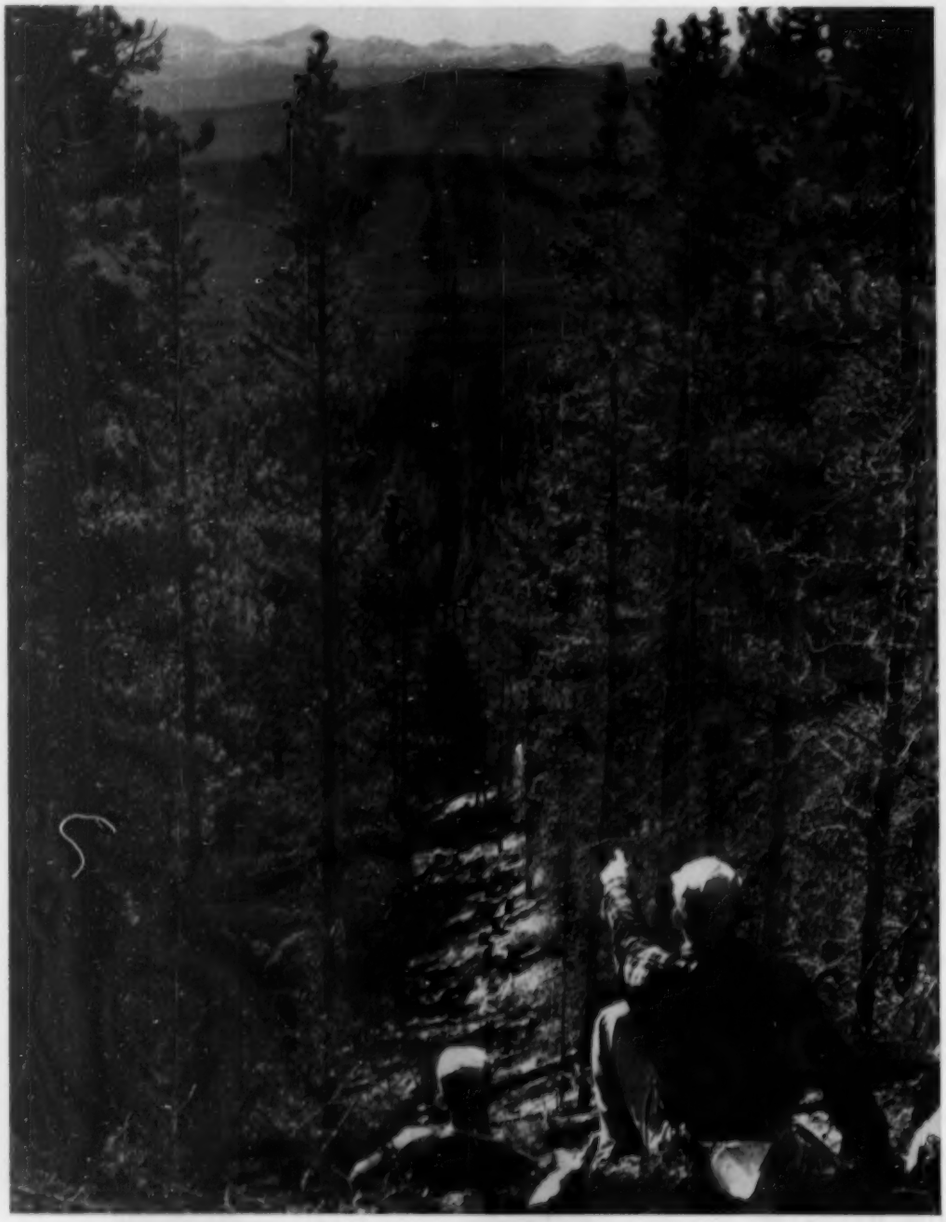
curity followed American procedure fairly closely, but was somewhat involved. The services of a trust company were necessary, legal formalities were cumbersome and company borrowers in some cases were obliged to amend their charters to provide authority to create debentures and to pledge them. The element of time consumed in carrying through the preliminaries leading up to the making of the loan was a drawback. Let it be said to the credit of the banks in Canada that we managed and worked with what we had. Many millions of dollars were loaned to the oil industry before our "Bank Act" was revised last year.

The 1954 revision of the "Bank Act" gave us the powers which the banks sought to facilitate loans to the oil industry and to simplify methods of taking security. Section 82 was written into the Act. It contains authority to lend money on the security of hydrocarbons* (wherever they may be), lands or leases on which any such hydrocarbons are or may be produced, partial interests in any of the foregoing and casing and equipment used in producing, seeking to produce and storing of such hydrocarbons. Security may be taken on any or all of the foregoing. The security forms required to comply with Section 82 of the Act are outlined in detail in a schedule of the Act. They are simple and execution carries with it all the powers given to the bank in the Act and the protection given to the borrower in the event of necessity to realize upon the security. We are not at liberty to make any changes in the security forms. We do have the choice of including in the security any or all of the items mentioned above and that can be the subject matter of negotiation between the bank and its customer. Each bank has the services and advice of competent geologists and petroleum engineers at its disposal and examination of title papers is referred to the bank's solicitors. Once the securities are furnished, the loans may fluctuate according to the needs of the borrower and any arrangement between the bank and the customer. However, if it is intended to give the bank security on additional property or specified items, then it is necessary to furnish fresh security forms enumerating the fresh or additional properties to be covered by the security.

Money has poured in from many sources to assist in the development of the oil industry in Canada. Much of the money came from experienced operators in the United States, who have done a great deal for the comparatively young industry in this country. Our Canadian banks have assisted in a very large degree and we look forward to the future growth of the industry with confidence. We, the bankers of Canada, are fully conscious of the opportunities which we have to assist in the development of this important natural resource—oil.

*The "Bank Act" defines hydrocarbons as solid, liquid and gaseous hydrocarbons including oil-bearing shale, tar sands, crude oil, petroleum and natural gas.



Blazing a trail across western Canada

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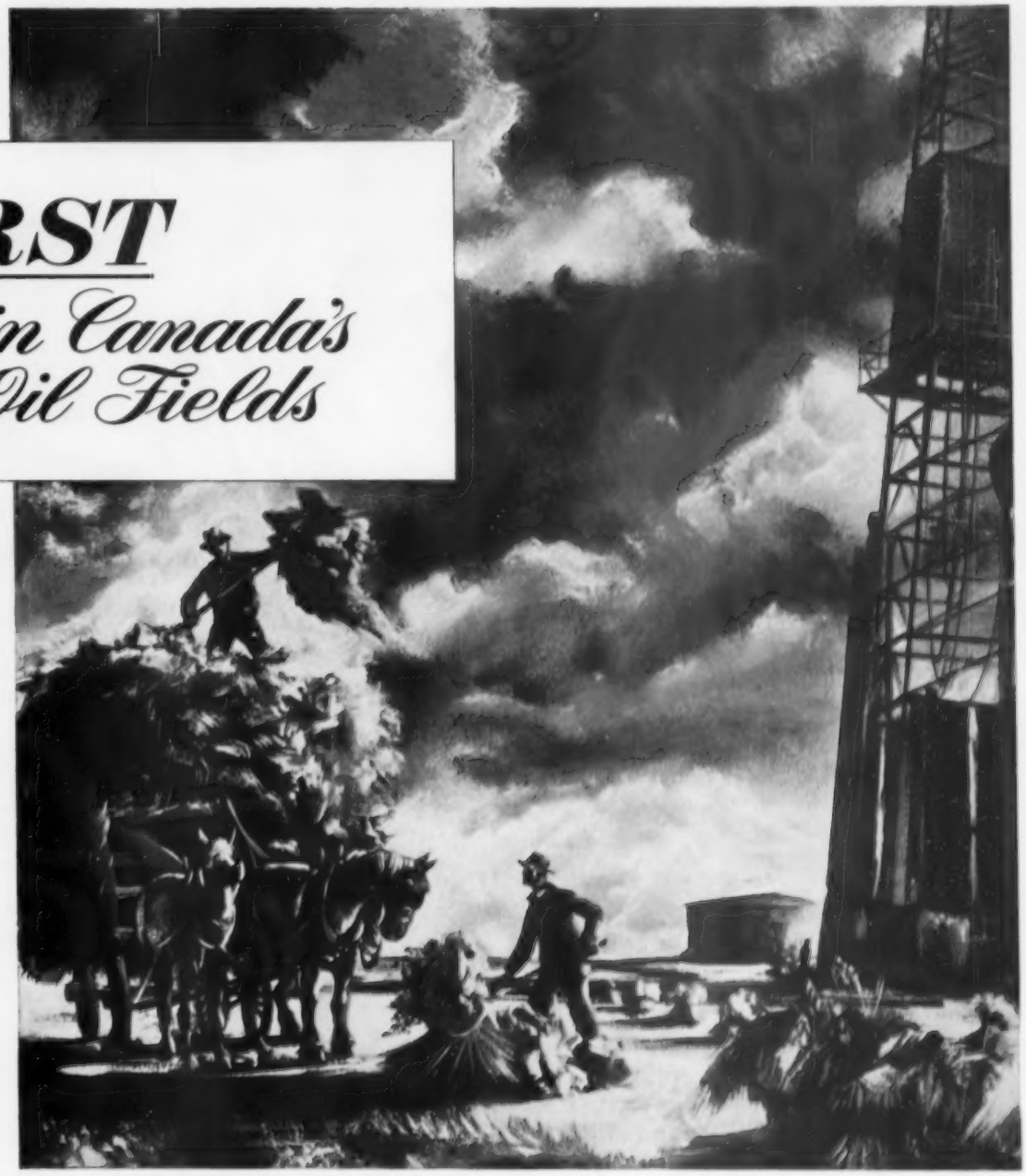

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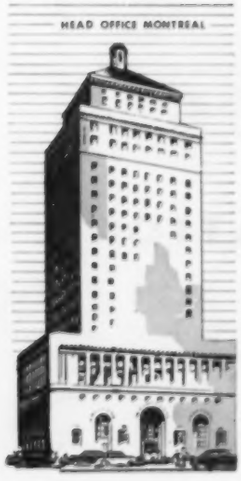

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"THE ORTHOFLOW FLUID CATALYTIC CRACKER"

dans la

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en el

SALON DE LOS ESPEJOS DEL HOTEL EXCELSIOR

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nella

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EXPLORATORY DRILLING CONTINUES ACTIVE

Shell seismic party shooting a shot hole during exploration work in the Pincher Creek area of southwestern Alberta.

EXPLORATORY DRILLING in Western Canada increased slightly in 1954 both in completions and footage drilled. The success ratio, however, was somewhat lower.

Data in the accompanying tabulations dealing with the 1954 drilling operations in Western Canada was prepared by a committee of the American Association of Petroleum Geologists headed by Dr. A. W. Nauss, president of Scurry Oils Ltd. Eastern Canada results were compiled by W. A. Roliff of Imperial Oil Ltd. The reports are being combined and will be published by Dr. Frederic Lahee of Sun Oil Co. in the June issue of the *Bulletin of the American Association of Petroleum Geologists* as part of his annual survey of exploratory drilling.

Completions in Western Canada in 1954 totaled 2,278 compared with 2,238 the previous year. Exploratory tests increased from 904 in 1953 to 936 last year. Successful wells dropped from 1,431 in 1953 to 1,364 and dry holes increased from 105 to 914.

Success ratio of all exploratory wells in Western Canada was 26.8 percent compared with 21.8 percent in Eastern Canada. Dominion ratio was 26.7 percent. In 1953 Western Canada had an exploratory success ratio of 30 percent. Included in exploratory tests are wells drilled as outposts to shallower or deeper horizons in known fields as well as those drilled as wildcats.

Of the 812 rank wildcats drilled in Western Canada last year, 185 were producers of oil or gas, a success ratio of 22.8 percent. The 1953 success was 15.6 percent. Success ratio in Eastern Canada was 8.9 percent compared with 3.4 percent in 1953. Of the 924 wildcats completed in the Dominion, 114 were oil discoveries and 81 are capable of producing gas.

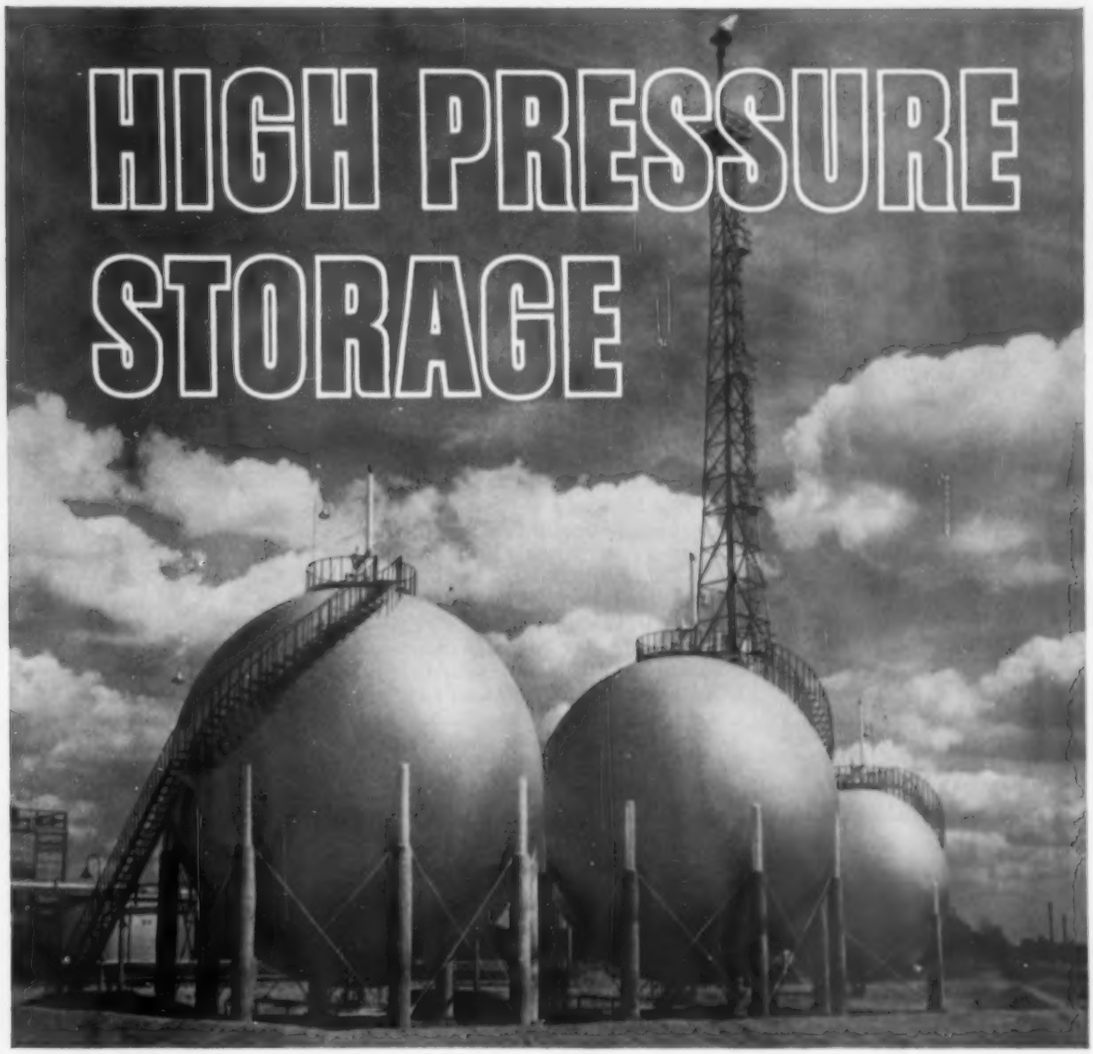
Average depth of exploratory wells in Western Canada was 4,575 feet in 1954 compared with 4,108 feet in the previous year and 3,923 feet in 1952. The number and depth of exploratory wells in all provinces is tabulated on the next page:

TOTAL WELLS DRILLED—WESTERN CANADA—1954 AND 1953

(Service Wells not included)

1954	—N.W.T.—			Brit. Columbia			—— Alberta ——			— Saskatchewan —			——Manitoba——			— West. Canada —		
	Dev.	Expl.	Total	Dev.	Expl.	Total	Dev.	Expl.	Total	Dev.	Expl.	Total	Dev.	Expl.	Total	Dev.	Expl.	Total
Oil	0	0	0	0	0	0	569	86	655	344	46	390	191	20	211	1104	152	1256
Gas	0	0	0	0	14	14	0	66	66	9	19	28	0	0	0	9	99	108
Dry	0	6	6	0	12	12	153	279	432	67	305	372	9	83	92	229	685	914
Total	0	6	6	0	26	26	722	431	1153	420	370	790	200	103	303	1342	936	2278

1953	—N.W.T.—			Brit. Columbia			—— Alberta ——			— Saskatchewan —			——Manitoba——			— West. Canada —		
	Dev.	Expl.	Total	Dev.	Expl.	Total	Dev.	Expl.	Total	Dev.	Expl.	Total	Dev.	Expl.	Total	Dev.	Expl.	Total
Oil	0	0	0	0	0	0	742	76	818	271	69	340	64	3	67	1077	148	1225
Gas	0	0	0	0	20	20	74	89	163	9	14	23	0	0	0	83	123	206
Dry	0	6	6	0	19	19	119	312	431	38	275	313	2	21	23	176	633	809
Total	0	6	6	0	39	39	935	477	1412	318	358	676	66	24	90	1336	904	2238



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Left, driving a stake into the frozen muskeg to anchor a rig guy wire at an Imperial wildcat in the Northwest Territories. Right, a drilling crew mixes mud in a Coleville, Sask. wheat field (Royalite photo).

There were 1,342 development wells drilled in Western Canada in 1954. Total footage was 4,920,785, an average of 3,660 feet. A year earlier total footage was 528,619 feet in 1,319 wells and the average depth was 4,000 feet. Eastern Canada drilling continued to be to shallow depths.

Development drilling by provinces is shown in the following table:

	NO. WELLS	FOOTAGE
Alberta	753	3,207,841
Saskatchewan	420	1,179,479
Manitoba	200	533,465
Western Canada	1,373	4,920,785
Eastern Canada	250	583,413
Total Canada	1,623	5,504,198

Development drilling in muskeg country in Western Canada was badly delayed in 1954 by a very wet summer. This was particularly true in Pembina. Drilling in this category may be more active this year if weather permits since there are a very large number of proven locations to be drilled in Pembina and the field now has a pipe line outlet. Although proration still is severe in Alberta, markets are expanding in the Pacific Northwest and west of the Great Lakes in the United States. Canadian domestic consumption continues to rise at a rate far exceeding that in the United States. Outlook is for a continued expansion in both exploratory and development drilling in the next few years.

Details of drilling operations in the various provinces are shown in accompanying tables on following pages. All successful exploratory wells are listed.

	NO. WELLS	FOOTAGE
Alberta	431	2,466,918
Brit. Columbia	26	150,030
Manitoba	103	239,238
N.W.T.	6	18,688
Saskatchewan	370	1,408,173
Western Canada	936	4,283,047
Eastern Canada	112	212,987
Total Canada	1,048	5,496,034

COMPARISON OF 1954, 1953, 1952 AND 1951 NEW FIELD WILDCATTING RESULTS

		COMPLETED DISCOVERIES					COMPLETED WILDCATS			
Year	Province	Total	Gas	Oil	Rate Gas	Rate Oil	Total	Rate Gas	Rate Oil	% Total
1954	Alberta	152	66	86	44%	56%	363	14.3%	18.2%	32.5%
	Saskatchewan	65	19	46	29%	71%	342	4.4%	8.2%	12.6%
	British Columbia	14	14	0	100%	0	14	28.6%	0	28.6%
	Manitoba	20	0	20	0	100%	87	0	23.0%	23.0%
	N. W. T.	0	0	0	0	0	6	0	0	0
	Western Canada	251	99	152	39%	61%	812	8.8%	14.0%	22.8%
	Eastern Canada	10	10	0	100%	0	112	8.9%	0	8.9%
	TOTAL CANADA	261	109	152	42%	58%	924	8.8%	12.3%	21.1%
1953	Alberta	61	40	21	66%	34%	292	13.7%	7.1%	20.8%
	Saskatchewan	26	4	22	15%	85%	273	1.5%	8.0%	9.5%
	British Columbia	7	7	0	100%	0	23	30.0%	0	30.0%
	Manitoba	3	0	3	0	100%	21	0	9.5%	9.5%
	N. W. T.	0	0	0	0	0	6	0	0	0
	Western Canada	96	51	43	53%	47%	615	8.3%	7.3%	15.6%
	Eastern Canada	2	1	1	50%	50%	59	1.7%	1.7%	3.4%
	TOTAL CANADA	98	52	46	53%	47%	674	7.7%	6.8%	14.5%
1952	Alberta	94	55	39	59%	41%	394	13.9%	9.9%	23.8%
	Saskatchewan	31	9	22	29%	71%	239	3.8%	9.2%	13.0%
	British Columbia	3	3	0	100%	0	6	50.0%	0	50.0%
	Manitoba	3	0	3	0	100%	35	0	8.6%	8.6%
	N. W. T.	0	0	0	0	0	12	0	0	0
	Western Canada	131	67	64	51%	49%	686	9.8%	9.3%	19.1%
	Eastern Canada	4	4	0	100%	0	47	8.3%	0	8.3%
	TOTAL CANADA	135	71	64	53%	47%	733	9.7%	8.7%	18.4%
1951	Alberta	71	48	23	65%	35%	305	16.0%	7.6%	23.6%
	Saskatchewan	5	3	2	60%	40%	49	6.1%	4.2%	10.2%
	British Columbia	3	3	0	100%	0	14	21.4%	0	21.4%
	Manitoba	1	0	1	0	100%	10	0	10.0%	10.0%
	Western Canada	80	54	26	68%	32%	378	14.3%	6.9%	21.2%
	Eastern Canada	1	0	1	0	100%	11	0	9.1%	9.1%
	TOTAL CANADA	81	54	27	67%	33%	389	13.9%	6.9%	20.8%

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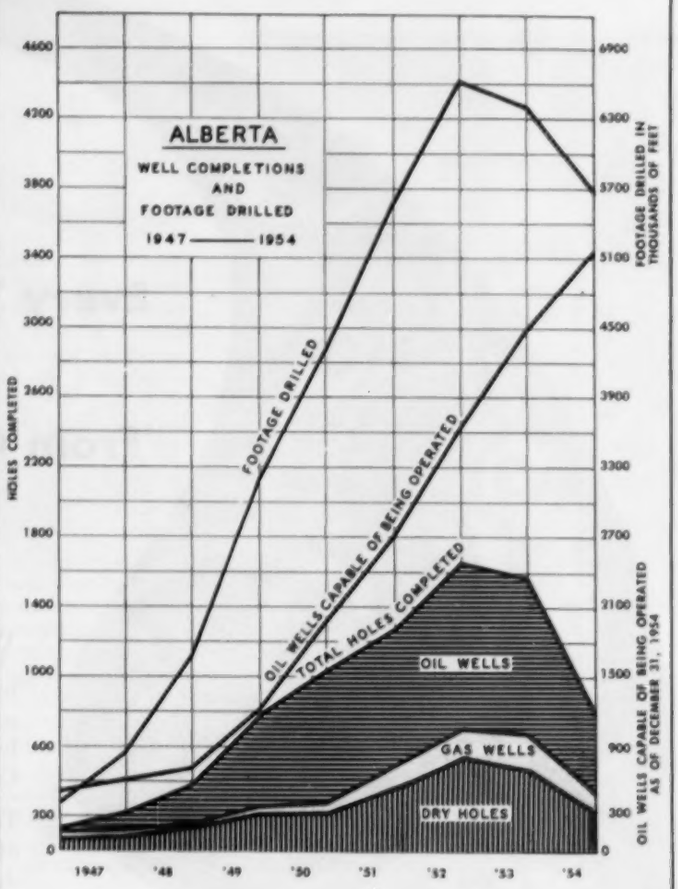

Exploratory Drilling

(Continued from page 138)

SUCCESSFUL NEW FIELD WILDCATS — WESTERN CANADA — 1954

ALBERTA — 55 OIL

Company, Farm & Well No.	Location	Completion Date	Total Depth Drilled	Total Completion Depth
Union Oil Oslanski 1	4-1-17W4	6/22	2,576	....
Northern Union Crown 4-9	4-9-13-13W4	11/20*	3,311	....
Socony CPR Cecil 10-10	10-10-14-12W4	10/31	3,285	....
Merrill Sun Brooks	4-19-18-15W4	12/9	4,630	....
Western Jenner 12-10	10-12-22-9W4	7/13	3,359	....
Dome Heathdale 11-28	11-28-26-8W4	9/26	3,841	3,670
Soc. W.C.N.G.N. Drumheller	14-23-29-20W4	3/28	5,559	4,558
(Sun) Pine 3-35	3-35-31-22W4	10/29	6,887	4,945
Seab'd Banff Wimborne 7-9	7-9-34-26W4	9/13	7,525	....
Calvan Charter Sun 1-29	1-29-35-11W4	11/6	3,610	....
Calvan Charter Sun 9-30	9-30-35-10W4	9/23	3,007	....
Superior et. al. Garrington 11-7	11-7-34-4W5	4/27	6,985	....
Sage Rosenheim C-11-29	11-29-37-1W4	1/19	2,490	....
Mill City Sweetgrass E. Kessler 1	7-30-38-7W4	1/25	2,580	....
Amurex Rich. H.B. Medin 1-2	2-32-38-3W5	3/10	8,987	8,766
Imperial Red Deer	5-5-39-26W4	7/29	5,350	....
Imperial Leslieville 1-33	1-33-39-5W5	10/23	7,100	6,850
Shell Greenglade A-8-17	8-17-41-1W4	2/3	2,951	....
Texaco McColl Alhambra A-2-1	2-1-42-6W5	11/30	8,733	7,805
Superior et al. Rocky M'tn House 10-27	10-27-42-8W5	3/24	6,350	....
Rio Prado Chauvin 16C-11	16-11-43-1W4	10/15	2,073	....
Fina Husky Triad E. Malmo	15-12-44-22W4	6/6	6,050	4,682
Amer. Northl'd N.W. Wainwright 2-8-10	10-11-45-7W4	3/21	2,383	....
Cleary Driedmeat 2	13-25-45-20W4	11/5	3,240	....
Sea'b H.B. et. al. Buck Lake 8-10-26	10-26-45-7W5	8/7	6,660	....
Sea'd. Gt. Plains et. al. Buck Lake 8-12-29	12-29-45-7W5	4/29	6,602	....
Nuco Fair Wainwright 1	8-5-46-6W4	10/2	2,238	....
Bay Shermak 16	16-15-46-20W4	11/4	3,335	....
Can. Delhi Gt. Plains Minnehik 11-33	11-33-46-6W5	1/13	6,825	....
Seab'd. Gt. Plains Baysel Buck Creek 6-15	6-15-47-7W5	2/12	6,260	....
Socony Seab'd Buck Creek 35-8	8-35-47-7W5	3/17	7,020	....
H.B. West Pembina 1	6-34-47-10W5	12/19	5,910	....
Imp. Can. Sup. Buck Creek 14-29	14-29-48-6W5	5/27	10,322	....

(Continued on page 142)

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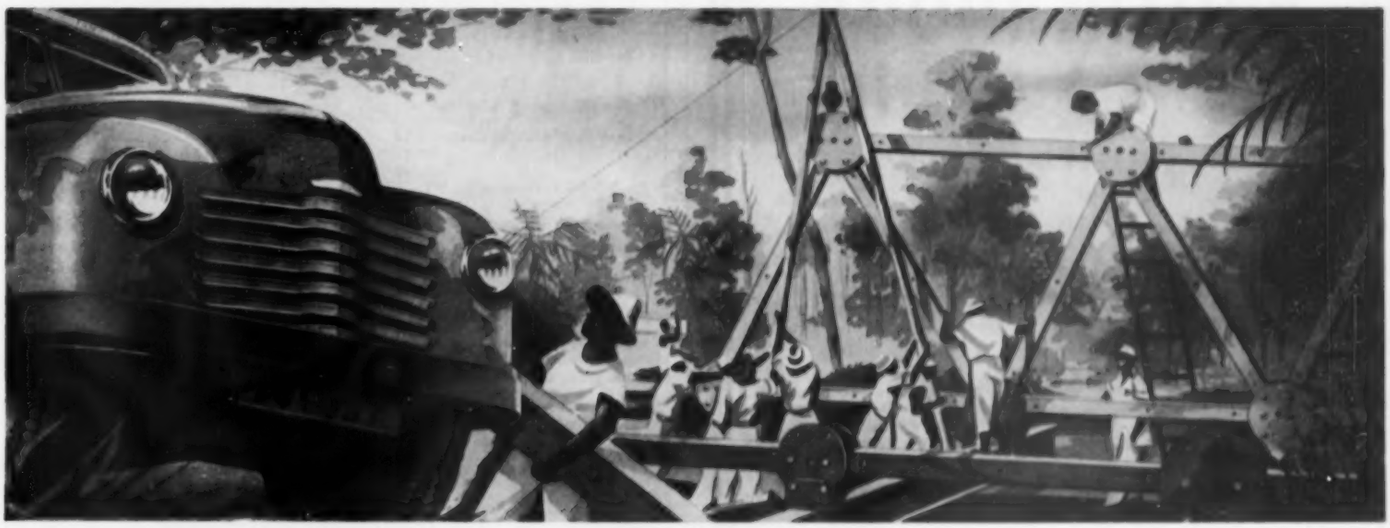

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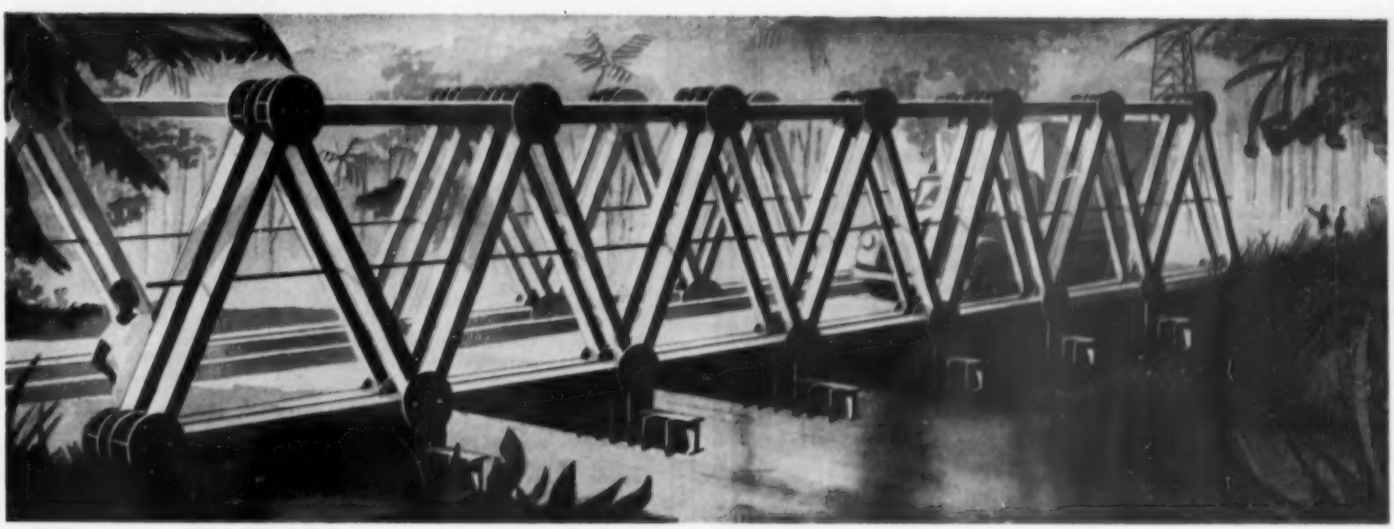

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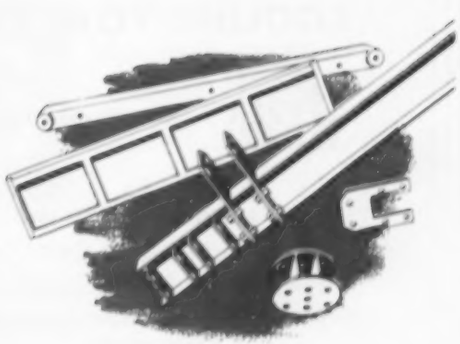

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Exploratory Drilling

(Continued from page 140)

Alberta Oil, continued

Company, Farm & Well No.	Location	Completion Date	Total Depth Drilled	Total Completion Depth
Socony Seab'd. Violet Grove 13-14	14-13-48-7W5	3/19	6,700	....
" " " " 30-2	2-30-48-7W5	1/14	6,840	6,630
" " " " 30-10	10-30-48-8W5	2/7	5,280	....
Stanolind H.B. Pembina Cr. E-1	12-6-48-9W5	3/31	5,656	....
" " " " D-1	8-36-48-10W5	2/15	6,693	....
Socony Seab'd Drayton Valley 16-8	8-16-49-7W5	1/13	5,750	5,450
Socony Seab'd N. Pembina 30-15	15-30-49-8W5	1/26	5,061	....
Stanolind H.B. Pembina Cr. C-1	2-6-50-9W5	2/20	6,365	....
N. Can. N. Pacific Whitemud 1	8-16-51-25W4	3/1	4,165	....
Imperial Woodbend 121	6-11-51-26W4	8/15	6,272	....
E. Cynthia Crown A-1	16-30-51-9W5	3/5	6,654	....
Oilwell Operators et. al. Granada 11-26	11-26-53-10W5	9/9	6,285	....
Shell Peers Strat Test 2	11-16-53-12W5	2/28	7,305	6,892
Imperial Fairydell 16-8-L	16-8-57-24W4	1/31	4,038	....
(Can. Gulf) Blue Ridge 5-14	5-14-58-8W5	4/23	7,650	7,200
Fina Cities Service Greencourt	6-7-29-9W5	7/23	8,075	5,010
Shackter Bonnyville 1	1-6-64-7W4	10/29	1,300	....
Bankers Griffin 2	1-6-64-7W4	10/24	1,210	....
(Can. Gulf) Little Smoky 10-27	10-27-67-22W5	5/16	8,804	....
H.B. Union Liberal 5-33	5-33-68-22W5	10/27	8,800	....
Gt. Plains Triad Muskeg Gilwood 1-9	1-9-73-18W5	4/2	8,355	....
Shell Reno 16-25	16-25-80-17W5	3/7	6,790	....

●

ALBERTA — 44 GAS

Company, Farm & Well No.	Location	Completion Date	Total Depth Drilled	Total Completion Depth
B.A.-H.B. Save Creek 10-8	10-8-2-1W4	10/30	3,949	....
New Brit. U.S. Smelting Pakowki 11-20	11-20-4-8W4	10/25	2,300	....
Can. Export Gas Irvine 7-28	7-28-11-2W4	8/18	1,738	....
Western Turin 33-7	7-33-11-19W4	9/25	3,726	....
Baysel Charter Twelve Mile Creek 11-32	11-32-15-12W4	10/8	2,410	....
Chamberlain E. Buffalo 6-10	6-10-21-5W4	10/11	3,133	....
Gulf States Homestead 1	10-31-21-13W4	6/5	2,927	....
Chamberlain W. Bindloss 6-28	6-28-22-5W4	12/10	3,030	....
Chamberlain N. Buffalo 6-16	6-16-22-6W4	8/10	3,074	....
Can. Export Gas Ohio Midcon Gem 6-7	6-7-23-17W4	10/30	5,125	....
Snell Home Sarcee 1	12-6-23-3W5	4/3	10,004	....
Homestead Territories Kinmundy 1	5-4-25-9W4	6/22	3,157	....
Homestead Territories Kinmundy 2	4-5-25-10W4	7/9	3,153	2,850
Socony CPR Wintering Hills	7-28-26-20W4	12/17	4,860	4,250
Socony CPR Kathryn 3-2	2-3-26-28W4	4/26	9,341	....
Gt. Plains Triad Socony CPR Wayne A-11-11	11-11-27-20W4	7/29	4,750	4,658
Merrin Delia Craigmyle Synd. 1	14-20-31-16W4	12/12	5,300	....
Cal. Stand. Grassy Island Lake 3	11-2-32-5W4	9/19	2,835	....
Shell West Olds A-16-15	16-15-33-4W5	6/22	11,575	9,623
B.A. Cities Service Gough Lake	6-11-36-18W4	12/15	5,404	3,938
Pacific Consort 2	7-14-37-7W4	3/25	2,787	....
Imperial Mirrer	12-16-40-22W4	3/19	5,652	....
Cities Service Wood Lake 1	6-20-40-4W5	9/26	7,920**	....
Ric. H.B. Husky Phillips Cameron 4-10	4-10-42-12W4	10/20	3,140	....
(Gulf) CPR Stevens 12	12-23-44-1W5	1/14	8,250	7,976
Cal. Stand. S. Faun 14-11	14-11-45-27W4	1/6	7,560	5,210
Red Rock 1	4-3-46-6W4	7/11	2,190	....
Banff Haselwood 4-26	4-26-46-22W4	7/20	5,729	4,408
Cuba Troutman 9	9-25-50W5	12/16	3,280	....
Husky Greta Joseph Lake 1	6-25-51-23W4	1/7	4,212	3,945
Union Carson W. Woodbend 14-31	14-31-51-26W4	7/29	6,193	....
L.B. Texaco Well 1	9-16-51-1W5	10/4	6,852	....
Texaco Deville A-12-2	12-2-52-20W4	9/12	3,700	....
Western Hairy Hill 6-10	10-6-56-13W4	9/27	1,954	....
Union Imp. E. Gibbons 7-15	7-15-56-22W4	5/21	3,500	3,100
Union Imp. Alexander 10-17	10-17-56-27W4	1/31	4,270	....
Baysel Namepi Creek 4-26	4-26-58-21W4	6/18	4,250	....
Union Imp. S. Vimy 11-15	11-15-58-25W4	8/16	4,050	3,480
Dome Imp. Westlock 6-27	6-27-59-27W4	11/17	3,460	....
Amerada Crown AE9-8	9-8-67-23W5	8/9	11,045	7,300
(Sinclair Banff) Sexsmith Cr. 1	13-20-74-6W6	3/30	4,101	3,000
Royalite Fina Saddle Hills 1	11-4-76-8W6	1/31	6,285	5,680
Gulf Braeburn 16-19	16-19-77-10W6	10/31	10,802	11,028
Pathfinder Legion Gas Expl. Admiral Bay Tree 1	6-33-79-12W6	2/10	2,615	....

* On Production 6/1/54 ** Suspended. Further tests scheduled for 1955.

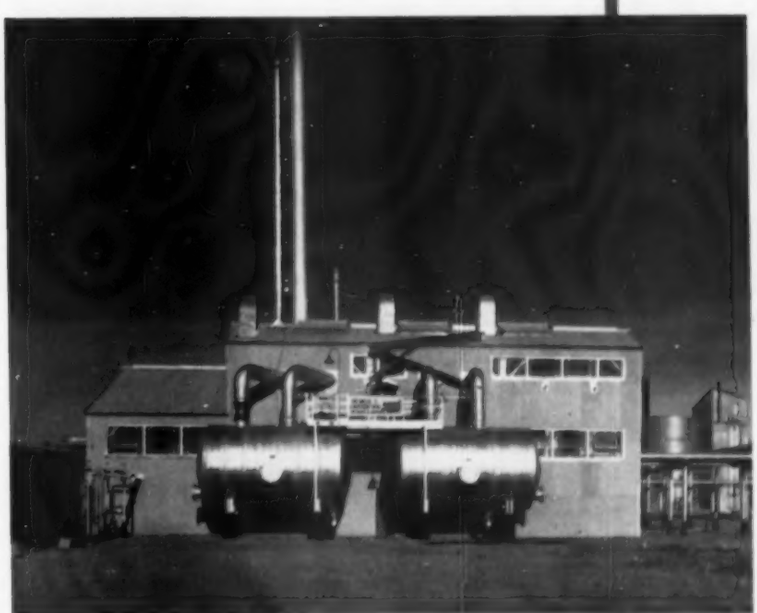
●

SASKATCHEWAN — 25 OIL

Company, Farm & Well No.	Location	Completion Date	Total Depth Drilled	Total Completion Depth
(Can. Gulf Dev.) Quinn	9-34-3-4W2	4/7	4,655	....
Imp. Nottingham 9-26-4-32	9-26-4-32W1	12/2	3,625	....
Imperial Alida 4-35-5-33	4-35-5-33W1	10/3	3,774	....

(Continued on page 144)

CANADA'S LARGEST H_2S SULFUR PLANT



Shell Oil Company of Canada, Limited recently placed on stream a plant that recovers over 50 tons of sulfur daily from hydrogen sulfide in natural gas. Located at Jumping Pound, Alberta, this is one of 21 domestic and foreign sulfur plants for which contracts have been awarded to Parsons.

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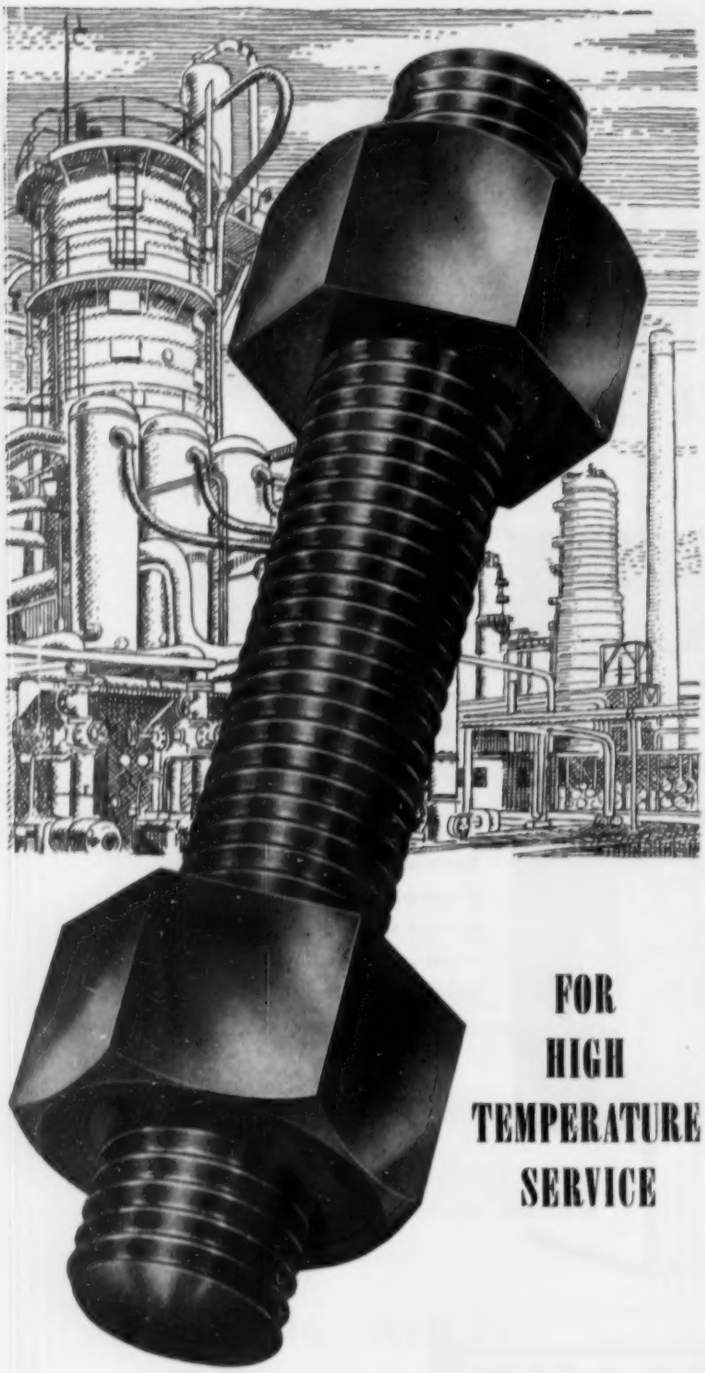

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Exploratory Drilling

(Continued from page 142)

Saskatchewan Oil, continued

Company, Farm & Well No.	Location	Completion Date	Total Depth Drilled	Total Completion Depth
(Can. Gulf Dev.) Walter 5	5-14-5-6W2	10/27	7,607	4,440
Shell Cullen A-8-28	8-28-5-7W2	1/11	4,657	4,640
Shell Viewfield A-5-12	5-12-6-10W2	9/12	4,731	....
Shell Holloway A-10-20	10-20-6-11W2	10/15	4,908	....
Shell Viewfield A-1-12	1-12-7-9W2	1/1	4,828	....
(Sooner Pete.) Gill 3-8	3-8-7-10W2	1/18	4,484	....
Shell Huntoon A-8-12	8-12-7-10W2	9/7	4,753	4,420
Central Del Rio Ralph 14-6	14-6-7-13W2	12/16	5,124	4,471
Tidewater E. Dollard Cr. 7-20	7-20-7-19W3	12/10	4,565	....
Tidewater Ajax Whitebear 4	9-12-9-3W2	10/28	4,960	4,100
Tidewater N. Shaunavon Cr. 1-34	1-34-9-18W3	6/21	4,650	....
Socony Woodley South. S. Illerbrun 21-8	8-21-10-18W3	9/24	4,644	....
Delhi Husky Phillips Richfield Bone Cr. 1	6-34-10-19W3	10/11	4,458	....
Socony Woodley South. S.E. Midway 20-5	5-20-14-19W3	11/19	3,720	.....
Socony Woodley South. E. Gull Lake 28-11	11-28-13-18W3	7/30	3,981	....
Sohio N. Wapella 13-13	13-13-15-1W2	8/4	2,870	....
(Husky) Verendrye 1	1-19-28-23W3	6/?	3,021	....
(Phillips Husky) Morengo 1	10-26-27-27W3	2/19	3,177	3,014
(Husky Phillips) Eastside	13-14-29-29W3	5/18	3,119	2,959
Sturgeon & Assoc. Smiley 3	11-31-30-26W3	3/5	2,980	....
Royalite Can. South. Coleville 61-20	14-20-31-23W3	8/6	2,720	....
Fargo West Epping 4-25A	4-25-47-28W3	11/25	2,000	....

●

SASKATCHEWAN — 13 GAS

Company, Farm & Well No.	Location	Completion Date	Total Depth Drilled	Total Completion Depth
Amurex Can. South. Cummings 1-10	10-17-12-29W3	6/28	1,560	....
" " " Hatton 1-10	10-1-13-29W3	6/14	1,580	....
" " " Moeller 1-10	10-21-14-28W3	6/?	4,037	....
" " " Herter 1-10	10-21-15-28W3	7/25	1,717	....
Socony Sohio Totnes 21-5	5-21-28-18W3	11/7	2,406	....
" " D'Arcy 23-15	15-23-28-19W3	7/23	2,450	....
" " " 31-2	2-31-28-19W3	8/5	2,558	....
Alminex Crystal 4-15	4-15-30-27W3	3/14	2,500	....
Canso New Superior et al. Viewfair 6-35	6-35-31-20W3	10/26	2,301	....
Canso Oil Prod. New Sup. et al. Hopedale 6-30	6-30-31-22W3	9/17	2,310	....
Can. South Oil Prod. Hoosier 10-12	10-12-31-27W3	11/26	2,465	....
Can. South. Oil Prod. Hoosier 6-31	6-31-31-27W3	3/27	2,448	....
(Phillips Husky) Antelope 1	9-21-32-28W3	7/23	2,895	2,465

●

BRITISH COLUMBIA — 4 GAS

Company, Farm & Well No.	Location	Completion Date	Total Depth Drilled	Total Completion Depth
Pacific Fort St. John 35	9-36-85-22W6M	31/19	5,593	....
Pacific Union Buick Creek 1	2816'S & 8485'W of Umbach Manu.	2/27	4,790	....
Pacific Sunray Montney 2	14-36-86-19W6M	12/19	6,442	....
Texaco N.F.A. Nig Creek 1	57° 03'45" N.Lat. 121 43'56" W.Long	212	11,999	....

●

MANITOBA — 2 OIL

Company, Farm & Well No.	Location	Completion Date	Total Depth Drilled	Total Completion Depth
Northern Pierson 7-11	7-11-3-29-W1	1/28	3,274	....
B.A. Can. Sup. Woodnorth 1	3-33-8-27-W1	4/6	2,884	2,530

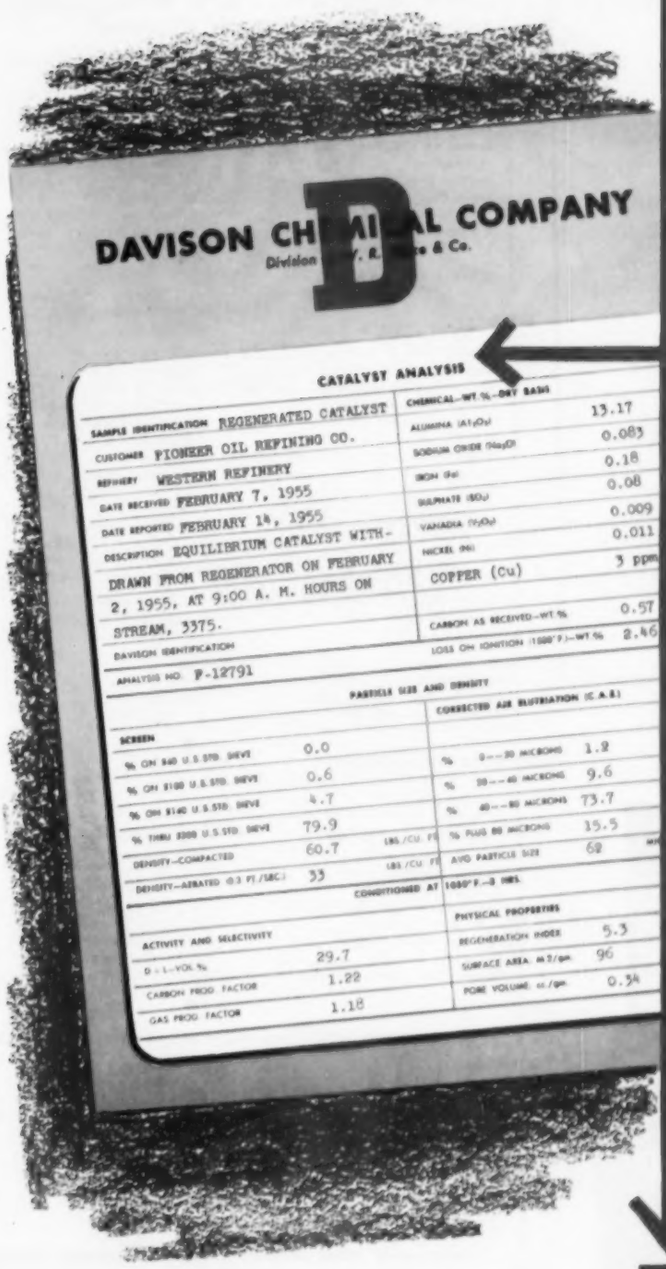
●

SUCCESSFUL NEW FIELD WILDCATS — EASTERN CANADA — 1954

ONTARIO — 5 GAS

Company, Farm & Well No.	Location	Completion Date	Total Depth Drilled	Total Completion Depth
T. Seynur-MacDonald No. 1	Esquesing Twp. Lot 15, Con. 15	Oct.	1,910	1,910
Imperial Oil-Imp. Calvan Hay 22-11	Hay Twp., lot 22, Con. 11	9/4	2,026	2,026
Imperial Oil-Imp. Howard 96-L.E.	Howard Twp. Lot 96, F.C.L.E.	11/19	1,637	1,637
Union Gas Co.-Union Enniskillen No. 26	Enniskillen Twp. Lot 1, Con. 5	8/10	2,260	2,260
" " " " " " 28	Enniskillen Twp., Lot 1, Con. 8	10/28	2,035	2,035

(Continued on page 146)


DAVISON CHEMICAL COMPANY
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CATALYST ANALYSIS
SAMPLE IDENTIFICATION REGENERATED CATALYST
CUSTOMER PIONEER OIL REFINING CO.
REFINERY WESTERN REFINERY
DATE RECEIVED FEBRUARY 7, 1955
DATE REPORTED FEBRUARY 14, 1955
DESCRIPTION EQUILIBRIUM CATALYST WITH-
DRAWN FROM REGENERATOR ON FEBRUARY
2, 1955, AT 9:00 A. M. HOURS ON
STREAM, 3375.
DAVISON IDENTIFICATION
ANALYSIS NO. P-12791
CHEMICAL—WT. %—DRY BASIS
ALUMINA (Al2O3) 13.17
SODIUM OXIDE (Na2O) 0.083
IRON (Fe) 0.18
SULPHATE (SO4) 0.08
VANADIA (V2O5) 0.009
NICKEL (Ni) 0.011
COPPER (Cu) 3 ppm
CARBON AS RECEIVED—WT. % 0.57
LOSS ON IGNITION (1000° F.)—WT. % 2.46
PARTICLE SIZE AND DENSITY
SCREEN
% ON 840 U.S. STD. SIEVE 0.0
% ON 5100 U.S. STD. SIEVE 0.6
% ON 5140 U.S. STD. SIEVE 4.7
% THRU 5200 U.S. STD. SIEVE 79.9
DENSITY—COMPACTED 60.7 LBS./CU. FT.
DENSITY—AERATED (0.3 FT./SEC.) 33 LBS./CU. FT.
CORRECTED AIR ELUTRIATION (C.A.E.)
% 0—20 MICRONS 1.2
% 20—40 MICRONS 9.6
% 40—80 MICRONS 73.7
% PLUS 80 MICRONS 15.5
AVG. PARTICLE SIZE 62 MICRONS
CONDITIONED AT 1050° F.—3 HRS.
ACTIVITY AND SELECTIVITY
D - L—VOL. %
CARBON PROD. FACTOR 29.7
GAS PROD. FACTOR 1.22
1.18
PHYSICAL PROPERTIES
REGENERATION INDEX 5.3
SURFACE AREA, M2/gm. 96
PORE VOLUME, cc./gm. 0.34

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Exploratory Drilling

(Continued from page 144)

SUCCESSFUL NEW-POOL WILDCATS — WESTERN CANADA — 1954

ALBERTA — 11 OIL

Company, Farm & Well No.	Location	Completion Date	Total Depth Drilled	Total Completion Depth
Ranchmen's 6-27	6-27-35-9W4	4/28	2,995	....
Can. Delhi Gt. Plains et al. Minnehik 10-31	10-31-46-6W5	2/20	7,000	....
Baysal Gt. Plains Seab'd Buck Creek 10-6	10-6-47-7W5	11/12	5,350	....
H.B. Pembina 16-8-47-7	16-8-47-7W5	4/12	5,205	....
H.B. Pembina 4-26-47-7	4-26-47-7W5	3/31	5,185	....
Stanolind H.B. Pembina Cr. A-1	12-13-48-9W5	4/26	5,366	....
Tellington 1	11-36-49-2W4	7/11	2,055	....
Socony Seab'd Drayton Valley 7-14	14-7-49-7W5	4/18	4,940	....
Trans Empire Campbell 20	10-20-54-25W4	4/7	3,820	....
Thunder Lake 9-9	9-9-59-5W5	12/18	6,535	....
H.B. Union Liberal 15-31	15-31-68-21W5	6/8	8,583	....

●

ALBERTA — 8 GAS

Company, Farm & Well No.	Location	Completion Date	Total Depth Drilled	Total Completion Depth
Chamberlain S. Buffalo 6-31	6-31-20-6W4	7/21	3,807	....
High Crest et al. Atlee 2	15-16-21-7W4	7/16	4,303	....
Gt. Plains Can. Sup. et al. Elkton 16-13	16-13-31-4W5	3/23	8,900	....
Calvan Provost 11-32	11-32-35-6W4	10/14	2,730	....
Imperial Provost 10-16	10-16-36-4W4	10/20	2,295	....
Mill City E. Kessler 16-29	16-29-38-7W4	9/20	2,417	....
Henderson Christie S. Chauvin 6-C-34	6-34-42-2W4	12/26*	2,275	....
Nelcalreda 1	10-1-49-27W4	8/22	4,764	....

*1953

●

SASKATCHEWAN — 3 OIL

Company, Farm & Well No.	Location	Completion Date	Total Depth Drilled	Total Completion Depth
Socony Woodley South. Success 26-16	16-26-16-16W4	1/14	3,445	3,345
Imperial Dewar 7-9V	7-9-31-26W3	1/14	2,475	....
Husky Dulwich 1	1-17-49-27W3	7/8	2,246	....

●

SASKATCHEWAN — 2 GAS

Imperial Cook Lake 7-33V	7-33-31-21W3	1/2	2,290	....
Imperial Coleville 7-1-32-23	7-1-32-23W3	5/6	2,308	....

●

MANITOBA — 8 OIL

Company, Farm & Well No.	Location	Completion Date	Total Depth Drilled	Total Completion Depth
Imperial Pierson 5-15M	5-15-3-29W1	11/4	3,394	....
B.A.-Union Kool 15-1	15-1-9-28W1	10/20	2,552	....
Sooner Hayhurst 8-15	8-15-9-28W1	8/17	2,560	....
Cal. Std. Daly 3-24	3-24-9-28W1	11/22	2,484	....
Dome Harris Cox Ebor 14-23	14-23-9-29W1	8/31	2,711	....
J. P. Owen Bekker	13-32-10-25W1	2/24	1,759	....
Cal. Std. South Virden	1-12-10-26W1	3/3	2,405	2,170
Canadian Devonian Hepburn	16-23-10-26W1	1/10	2,029	....
Dome et al. South Harmsworth	13-26-11-26W1	12/30	2,031	....

●

SUCCESSFUL NEW-POOL WILDCATS — EASTERN CANADA — 1954

ONTARIO — 2 GAS

Company, Farm & Well No.	Location	Completion Date	Total Depth Drilled	Total Completion Depth
Union Gas Co.-Union Dawn No. 176	Dawn Twp. Lot 23, Con. 3	1/25	1,683	1,640
Imperial Oil-Imperial Sombra No. 27-7	Sombra Twp. Lot 27, Con. 7	6/19	2,056	1,658

●

SUCCESSFUL SHALLOWER-POOL TESTS — WESTERN CANADA — 1954

ALBERTA — 2 GAS

Company, Farm & Well No.	Location	Completion Date	Total Depth Drilled	Total Completion Depth
Chamberlain N. Buffalo 6-16A	6-16-22-6W4	12/3	....	372
Cuba Harish 3	3-12-50-27W4	12/7	....	3,075

●

SUCCESSFUL DEEPER-POOL TESTS — EASTERN CANADA — 1954

ONTARIO — 1 GAS

Company, Farm & Well No.	Location	Completion Date	Total Depth Drilled	Total Completion Depth
Imperial Oil-Imperial Bickford No. 19	Sombra Twp. Lot 6, Con. 11	1/28	1,866	1,844

PANELLIT INFORMATION SYSTEMS

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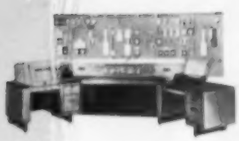
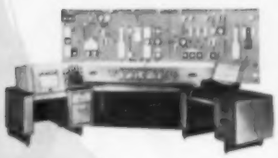


YOU



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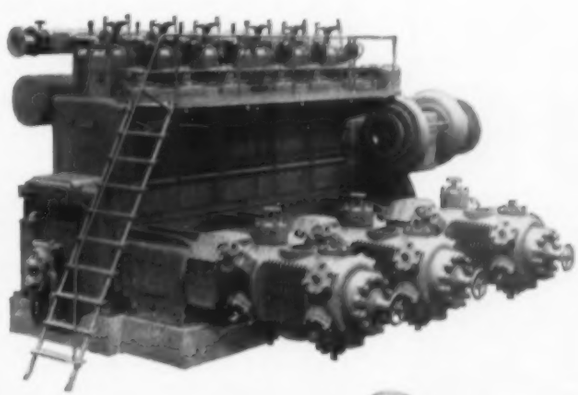


Clark sets the pace in compressor progress

75 YEARS

A laundry section complete with washing machine is part of the trailer camp in the background at an Imperial oil wildcat well in the Northwest Territories.

HOW TO

By Leslie Orr Rowland*

ONE OF THE FEW countries of the world, outside of the United States, where a highly favorable political climate still exists for oil company operations is Canada. To this factor, as much as to the presence of almost 900,000 square miles of territory underlain by sedimentary rocks which may contain crude oil, can be attributed the appeal which has drawn to this relatively new oil search area most of the major United States oil companies and a good many from England and continental Europe.

Unfortunately, not all the companies which have entered Canada in the quest for oil have been successful in establishing production structures which guarantee them returns on their investments. Partly this has been due to the inherent element of risk in any exploratory operation, but it has also been caused by over-optimistic appraisals of producing properties and by failure to study closely enough the experience of operators who have weathered the boisterous period of speculation. A study and understanding of several primary factors can take most of the man-made risk out of Canadian operations and leave only the natural risk imposed by the limitations of scientific methods of locating potential oil deposits. Then, if the operator starts with adequate capital, he has a reasonable chance of striking an average or better discovery rate and winding up with a profit on his investment.

The first major decision to be made is a choice between straight wildcat operations and buying into proven properties. Some companies may wish to combine both types, the production bringing in current revenue to support the wildcat program, but in general, proven production can be bought only at a price which returns income about equivalent to interest on corporation bonds. Recently one

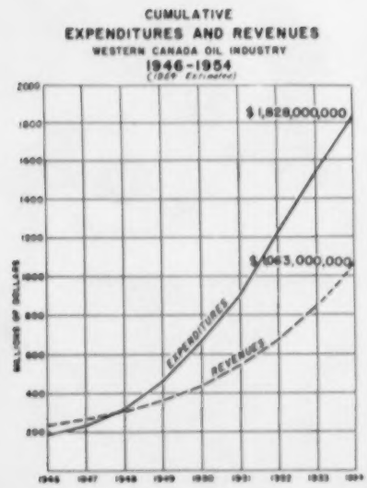


Chart courtesy Imperial Oil Ltd.

*Editor, *Oil in Canada*.

operate at a profit in Canada

major wildcatter has been successful in selling a large block of proven productive acreage, mostly undeveloped, to a major refiner, for a capital sum to be paid out of production. This wildcatter considers it more profitable for the long term to dispose of any production discovered and reinvest the proceeds in more wildcatting. There is an obvious limit to the number of operators who could make success of such a policy. The limit is the availability of purchasers willing to pay a premium for proven production. For the past three years there has been principally a buyers' market for crude oil, with practically no long term contracts and a strict proration system in both Alberta and Saskatchewan.

The choice of the type of operation may be governed, of necessity, by the size and resources of the company. Operators in western Canada can be divided generally into four categories, to which different principles apply.

The first and usually the largest, although not always the most successful, is the major integrated company which can sustain a multi-million-dollar exploration program. This class of company in Canada, so far, is still laying out more capital each year than it is getting back. The largest operator of an integrated type, Imperial Oil Ltd., in 1954 spent an estimated $30 million on capital additions in the form of producing facilities and an additional estimated $30 million on exploration and wildcat drilling which under its conservative financial policy it charges to current operating expenses. In the same year its total crude oil production was no more than 36 million barrels gross, before royalty deductions and operating expenses, which at an average field price of about $2.50 would return $75 million gross after royalty. It is of interest that Imperial's net earnings in 1954 are estimated to have been slightly under $50 million from all operations and that this represented a figure more than double the 1949 earnings of $24 million. Yet in the same period of six years the total capital expenditures amounted to more than $360 million and the expenditures on exploration written off as current expenses were another $130 million. Only a company with enormous resources, and with a credit rating which has just permitted it to sell a debenture issue of $50 million at a net cost of 3.64 percent, could consider a program with the scope of Imperial's.

The second category is that of companies with substantial resources, but not integrated, which can undertake wildcat drilling on selected acreage, either alone or in partnership with others, and either as government exploration permit rights or on a farmout basis from the majors. Such a company can also blend into its program a judicious selection of proven and semi-proven acreage, either on a cash bonus basis at a government lease sale or by purchase or farmout from other companies.

The third category is the small company with limited resources and credit, which cannot justify the risk of a wildcat program and should (although they do not always) limit activities to the purchase or farmout of acreage which appears to have a better than average prospect of yielding commercial oil. It is generally considered at present, in western Canada, that a company with less than five to ten million dollars capital is taking more than the average risk of loss in attempting more than a third category program.

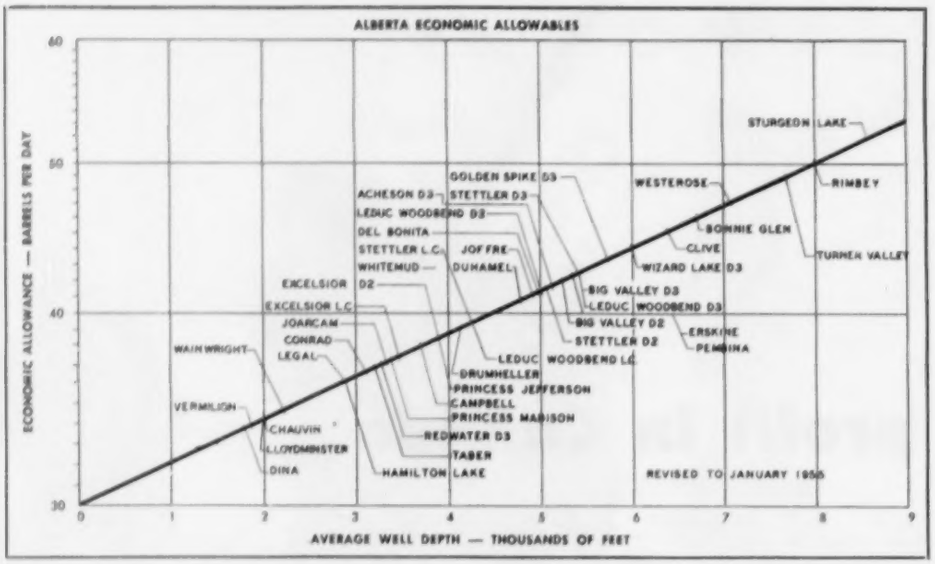
In the fourth category are the purely speculative concerns which, unfortunately, are permitted under Canadian laws to embark on wildcat programs or hazardous development operations without the minimum capital considered to conform to the risk which must be taken.

There are, of course, overlapping classifications, but as a quick reference these four categories serve to identify the main type of operations which should be appraised by new companies intending to operate in Canada.

The first and most useful decision to be made is: which type of operation to plan for? Once this decision is made, the immediate consideration is the land acquisition program. There are only four kinds of oil and gas rights holdings available in any of the four western provinces of Canada. These are the Crown reserve lease, the Crown exploration permit, the private lease and the farmout. The farmout is a generic term which could apply to any of the three basic types of holdings.

The customary basis for a wildcat program is the Crown exploration permit. In most regions now, except far northern

Cats clear Pigeon Lake location. If frost leaves the ground, it's a muddy business. Stanolind photo.



How to Operate in Canada

Alberta, some parts of Saskatchewan and the less favorable areas of Manitoba, Crown exploration permits are no longer granted without a cash bonus payment. The practice of putting Crown exploration permits up for competitive bid is simply a reflection of the scarcity of available land. Purely wildcat parcels can still be bid in for prices as low as a few cents per acre. At the opposite end of the scale, a block of four townships, or more than 92,000 acres, was taken for a cash bonus of more than $13 million last winter, or an average cash bonus of more than $140 per acre, because of its location in relation to the Pembina oil field. The adjoining reservation of the same size, bought for $11 million at the same auction sale, now contains six dry holes which blanket a large portion of its total area: an illustration of the inherent risk in a wildcat program.

For obvious reasons, Crown exploration permits are granted only on wildcat acreage. In Alberta they are essentially prospecting licenses, entitling the holder to exclusive exploratory rights in an area not exceeding 100,000 acres in area, for a maximum period of three years, for a total fee of $250 plus $1 per acre in extension fees, provided a satisfactory program is carried out with approval of the Alberta government. Crown reservations in Saskatchewan and Manitoba have been issued on terms established by negotiation, but in general the cost of retaining them has been lower because the stage of development in these provinces has been lower and cash bonus bids have not been necessary. This condition has been modified in recent months by an increased discovery rate and both provinces are likely to put up exploration permits for competitive bid in future.

In Alberta, a reservation may be converted into a 21-year renewable lease at any time during its term, but the holder may select not more than half the total acreage. There is no limitation on the pattern of selection except when a selection is made following a commercial discovery on the block. In this case a lease must be taken within 90 days of completion of the well and may not include more than nine square miles in a single block of contiguous acreage. There is no obligation to lease up to the limit of 50 percent of the acreage, but whatever is not selected reverts to the provincial government and may be disposed of at its discretion.

Natural gas leases are dealt with similarly to oil leases, but with the limitation that only the zones encountered in drilling the discovery well may be leased out of the reservation, and that the amount of acreage which may be leased horizontally depends on the depth of the lowest gas-bearing zone, with a range from six to ten square miles in area.

In Saskatchewan, original Crown reservations provided for retention of specific acreage by the provincial government at the time of issue of the exploration permit, to the extent of 25 percent of the permit area. For the past four years the regulations have been uniform with Alberta's, except that the Crown reserve portion on conversion to lease varies from 40 to 60 percent depending on the size of lease taken. The maximum size of a contiguous lease parcel is 12¼ square miles.

Manitoba has been the least expensive province for exploration rights because of its very small relative acreage of good sedimentary rocks. The provincial government, to encourage activity, granted early reservations without cash bonus payments. Now, in the case of any portions lapsed or returned on lease conversion, cash bonus bids are being asked. The prices paid, however, in the initial auction sale last summer, were considerably lower than the average in Alberta.

In general the provincial governments now adopt the realistic policy of weighing the relative returns from exploration permits followed by eventual conversion to lease against these from direct lease sales. As the intensity of drilling grows, the necessity of granting large exploration blocks will gradually disappear, probably to be replaced by a selective offering of lease parcels as activity in specific areas causes indicated values to rise.

Activity in British Columbia has been limited almost entirely to natural gas prospecting, and land holdings are mostly in the form of permits and licenses. Maximum area is 256,000 acres for a permit block with full geological and geophysical rights, while a license which permits wildcat drilling is limited to a maximum of 11,520 acres of which half may be leased for the usual 21-year term. There is no limit on the number of blocks which may be held by one company or a group.

The Crown exploration reservation type of entry into the Canadian oil business is one which requires a very large capital investment to secure an adequate spread of risk and cannot be undertaken with any reasonable success except by a multi-million-dollar enterprise. A normal exploitation of a suitable spread of acreage may take two or three years and the return of both capital and income is expected to be slow although it can be substantial.

The easiest, but generally the most expensive, method of entry is by the Crown reserve lease. In Alberta, 85 percent of all mineral rights are vested in the provincial government, so that, regardless of the primary stages of tenure, the bulk of productive acreage is going to wind up under this type of lease eventually.

Crown lease purchases are all at public sealed bid auction. The government calls for tenders on specific parcels, usually in quarter sections, with a closing date on which all bids are opened. The government reserves the right to reject any tender not considered high enough for the type and location of the acreage, and in almost all sales some rejections occur. The full amount of the tender must be included by certified check. Normally the bidder has a year's time limit on exploitation drilling, but in the case of proven acreage the first rig is often moving onto the property as soon as the successful buyer can reach a telephone. Immediate development, especially in the tightly pro-rated market condition existing in Alberta, is essential for the maximum possible return on the investment, especially when bids of one million dollars or more per quarter are still being made on some highly favorable properties.

Recently the Alberta Government introduced a new type of lease called a "drilling reservation," which commits the buyer to drill one well into a specified formation on each block of acreage, in return for the right to lease a specified quantity of land in the block. This type of lease is designed partly to encourage exploratory drilling in wildcat or semi-proven areas, and partly to stimulate higher bidding by giving bidders the benefit of government geological opinion as to the possible productive formations to be encountered in the area. It is essentially a combination of reservation and lease.

The Crown reserve lease is the exclusive medium for acquiring property in proven fields

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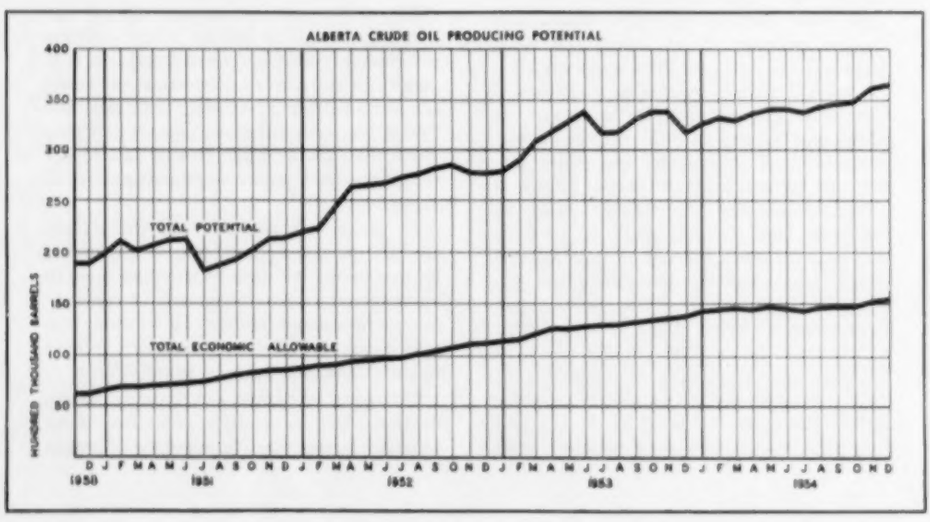

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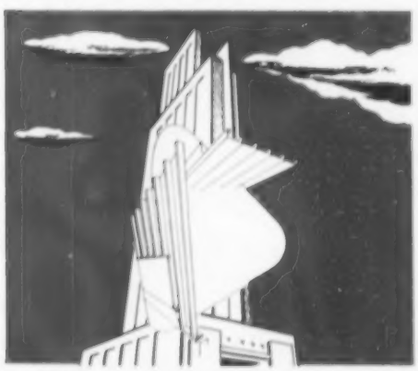

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on provincial government mineral rights. It is rapidly replacing the Crown exploration permit in all areas except those in the far north or other regions where difficult ground conditions make it essential to explore on a vast scale. It is significant that the only big reservations taken in recent months have been north of Township 60 and in the foothills of the Rocky Mountains.

Crown reserve leases are created in two ways: either by reversion from exploration permit blocks after lease selection, or by original offering without the exploration stage. The latter type is often the result of a discovery on freehold acreage which proves up Crown rights in the area and induces the provincial government to offer its rights as leases. This situation occurs more often in eastern Saskatchewan and in Manitoba than in Alberta, as the bulk of mineral rights in the eastern prairies are freehold. In all three provinces it is possible from time to time to buy both wildcat and development Crown reserve leases, but for obvious reasons the wildcat lease purchase is a highly speculative means of acquiring property. In the eastern prairies it is seldom possible to get more than a section of contiguous rights in either wildcat or development areas, so that for an economic operation it is usually necessary to arrange for a freehold lease or a farmout of adjoining acreage.

Since the period of great activity in western Canada has lasted for more than eight years, the amount of private lease acreage which can still be obtained on original lease is negligible. It is possible, however, to take assignments of leases on freehold, and the terms of private leases are usually very similar to those of government leases, so that the same principles of evaluation can be applied. One feature of history that makes private holdings very scarce in Alberta is that, out of some 16,000,000 acres of freehold, 15,400,000 acres belong to the railway companies and to the Hudson's Bay Co. The former are mostly committed under a long term agreement from Canadian Pacific Railway Co. to Canadian Gulf Oil Co., while the latter are entirely vested in Hudson's Bay Oil and Gas Co. Ltd., owned jointly by Hudson's Bay Co. and Continental Oil Co. None of them have yet been made available to any other operator except on a farmout basis.

Farmouts are almost the only means of acquiring freehold rights at the present stage of development. They are also available constantly in respect of Crown leases or exploration permits held by companies which wish to spread or share their risk, or which have more acreage than they can process within the time limit of their reservation or drilling commitments.

Recent large farmouts in both Alberta and Saskatchewan have involved as much as five million acres of reservations, and commitments to spend up to $10 million on exploration and wildcat drilling within a term of two or three years. Two large operators in Saskatchewan, the Tide Water Associated Oil Co. group and the Sohio Petroleum Co. group, each took reservations in 1949 of approximately ten million acres. A great deal of this property has since then been farmed out or surrendered and some still remains available for farmouts to other companies.

Typical farmout terms on development acreage involve the payment of a specific number of barrels at a percentage rate of current production; or the payment of a gross royalty as an over-ride during the life of any successful wells; or the contribution of other acreage to a joint venture. Wildcat farmouts usually require the company receiving the farmout to drill one or more wells in return for a specified share in the property. A common arrangement is to offer a half interest in the first well and the property for assumption of full costs of the first well.

The farmout is the only type of acquisition in which the operator can secure an acreage interest without the expenditure of any cash on the land.

The cost of acquiring acreage is now fairly well balanced in accordance with the indicated prospects of production. Thus the only way to make a profit on land acquisition is to be lucky enough to pick a future discovery area when it is still wildcat territory. The cost of proven acreages has fluctuated in the past four years from a high peak, at which many purchasers have been unable to get back even their purchase price, to a realistic level of current prices which reflect quite accurately the probable trend of production allowables and crude oil markets on a conservative basis.

Crown exploration permits remain the cheapest form of purchase for companies with large resources, provided they hit the average discovery ratio. No other type of operator should be in this kind of business, unless he intends to speculate on the possibility of a discovery being made on an adjacent block in which exploratory activity is going on. The risks of this type of speculation are too apparent to require any comment, although some brokers have made a comfortable living for a few years by well-selected speculative holdings on which they do not intend to do any actual development themselves.

The range of cash bonus prices for exploration permits in the past two years has been from zero to $1,400 per acre. A recent exploration permit sale early in February brought the Alberta government $341,760 in cash bonus for a total of 132,800 acres—an average price of $2.60 per acre—for the right to explore property some distance south of the Sibbald gas field on the Alberta-Saskatchewan boundary.

The maximum cost of holding fees is $1 per acre for the three-year limit of the term, while average geological and geophysical exploration costs will run to $1.50 per acre. It

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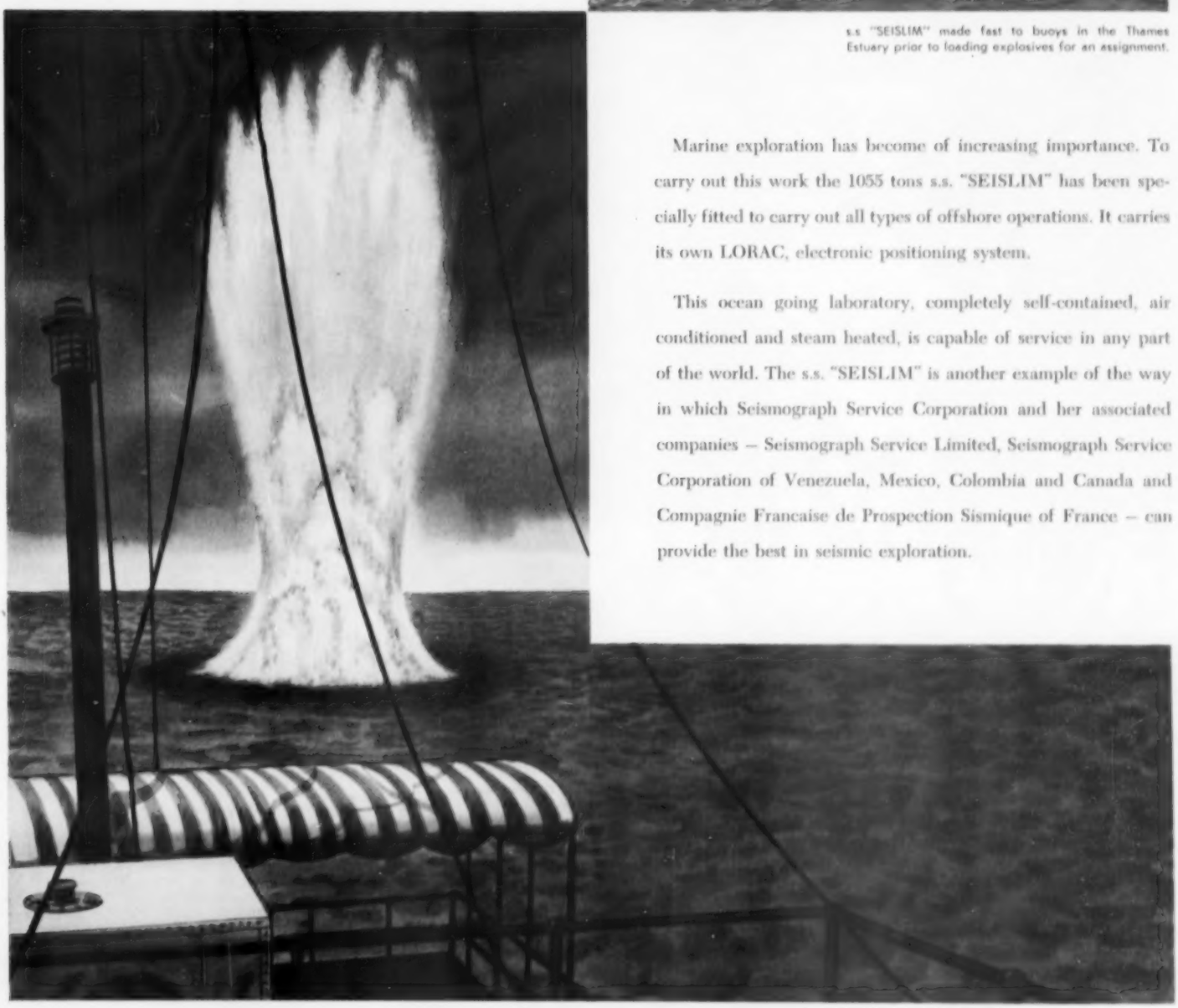

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can be assumed that a wildcat drilling program would require ten wells, as a fair average, on this size of reservation. The average cost in the region would be $50,000 per well. The total cost of normal operations on this one reservation can then be assumed as around one million dollars in the primary phase.

The cost of wildcat drilling is extremely variable, running from a low of $25,000 for shallow Mississippian tests in Manitoba, at depths as low as 2,000 feet, to deep wells in the Alberta foothills reaching 14,000 feet and costing up to $1,000,000 or more. The average 5,000- to 7,000-foot wildcat in most of Alberta or Saskatchewan can be counted on to cost $100,000 to $125,000.

Exploration costs tend to average the same in all areas, as the extra cost of far north exploration (double the cost of geophysical work on the plains) is balanced by the lower prevailing scale of acquisition cost of reservations. The decision to select a certain area for operations must be based on a consideration of this factor, the cost of drilling an adequate number of wildcats, the available or possible transportation channels and their cost per unit of production, and the speed with which a field can be developed if a discovery is made.

Dr. George S. Hume, one of Canada's leading geologists in the employ of the Dominion Government, has contended for a long time that the Rocky Mountain foothills region offers the best prospects of all western Canadian search areas, in terms of return on money spent. Recent discoveries in the Cardium sand and the Mississippian limestone formations tend to support his contention, but the cost is such as to bar any but major companies from most operations, except on a farmout basis. The small companies in the Pembina field, for example, and in the Sturgeon Lake Devonian coral reef fields, have mostly farmed out their acreage interests to majors for a royalty interest which relieves them of the cost of development, a factor as important in these areas as the original cost of finding the oil.

Development costs and drilling time are important in the current state of markets for Canadian crude, because every well capable of producing is assured of its prorated share of a slow over-all growth. Thus there is a premium on areas such as Pembina where an average well can be completed in 18 days at a cost of $62,500, and where an immediate pipe line outlet is in use. The faster a well gets into production, the faster it starts earning back its cost. In Sturgeon Lake, a converse problem of no pipe line outlet is currently holding back development which costs $250,000 per well. The selection of an area, depending entirely on judgment and the ability to forecast trends in pipelining and market directions, is a basic matter which can make or break a Canadian wildcat program.

The purchase of Crown reserve leases, as a cost problem, is best determined by appraisal of the property offered from the standpoint of probable recovery and average production rate over the payout period, and a rigid adherence to a reasonable price on the tender. Many companies which paid prices at Crown reserve sales a few years ago based on hope rather than analysis will admit now that they would have been better off if their bids had not been accepted. The factor of production rate is now considered more important than that of gross oil reserves, as a price which would represent a very reasonable value of oil in the ground at 100 barrels per day withdrawal could bankrupt the purchaser at 50 barrels per day, on the same quantity.

The cost of exploration and drilling should be about the same whether the operator uses its own crews or contracts the work. Except at odd times during the rapid exploitation period of the past eight years, there has been no shortage of either geophysical crews or drilling rigs in western Canada and costs have tended to be on the low side. Several major companies maintain their own crews, but in no case does the company depend exclusively on them. Imperial, the largest operator and largest employer of company-owned crews and rigs, contracts all its development drilling and a substantial part of its wildcatting.

The cost of drilling a wildcat well, as explained, varies widely by regions. Development wells can be estimated very closely from past experience in the region. Manitoba shallow wells of 2,000 to 2,500 feet depth can be completed and equipped for $25,000 to $30,000 and current rate allowables are 70 to 100 barrels per day. Saskatchewan shallow wells of 2,500 to 2,600 feet can be completed for $30,000 to $35,000 and medium depth wells of 4,600 feet for $50,000. Alberta medium depth wells of 5,000 to 5,500 feet vary from $60,000 to $75,000, while deep wells of 7,000 feet run $95,000 to $105,000 and extra deep completions at 8,000 to 9,000 feet can cost between $150,000 and $250,000.

Recent prices of Alberta Crown reserve leases show recognition by bidders of two important elements in producibility: the effect of economic allowables, and the probable long-term restriction of markets with production capacity exceeding demand.

The Alberta government in 1952 worked out a schedule of "economic" allowances for all producing fields and wells, based on the amount which an operator should have to produce to pay operating expenses and depreciation and depletion, according to the depth of the well to the average pay zone top in the field. This is the basic allowable which is permitted to every well provided the total demand for Alberta crude exceeds it. So far the total demand has never fallen below it. It has a double effect. For wells capable of producing more, it insures a break-even provided the operator did not pay too high a price for acreage. For wells whose

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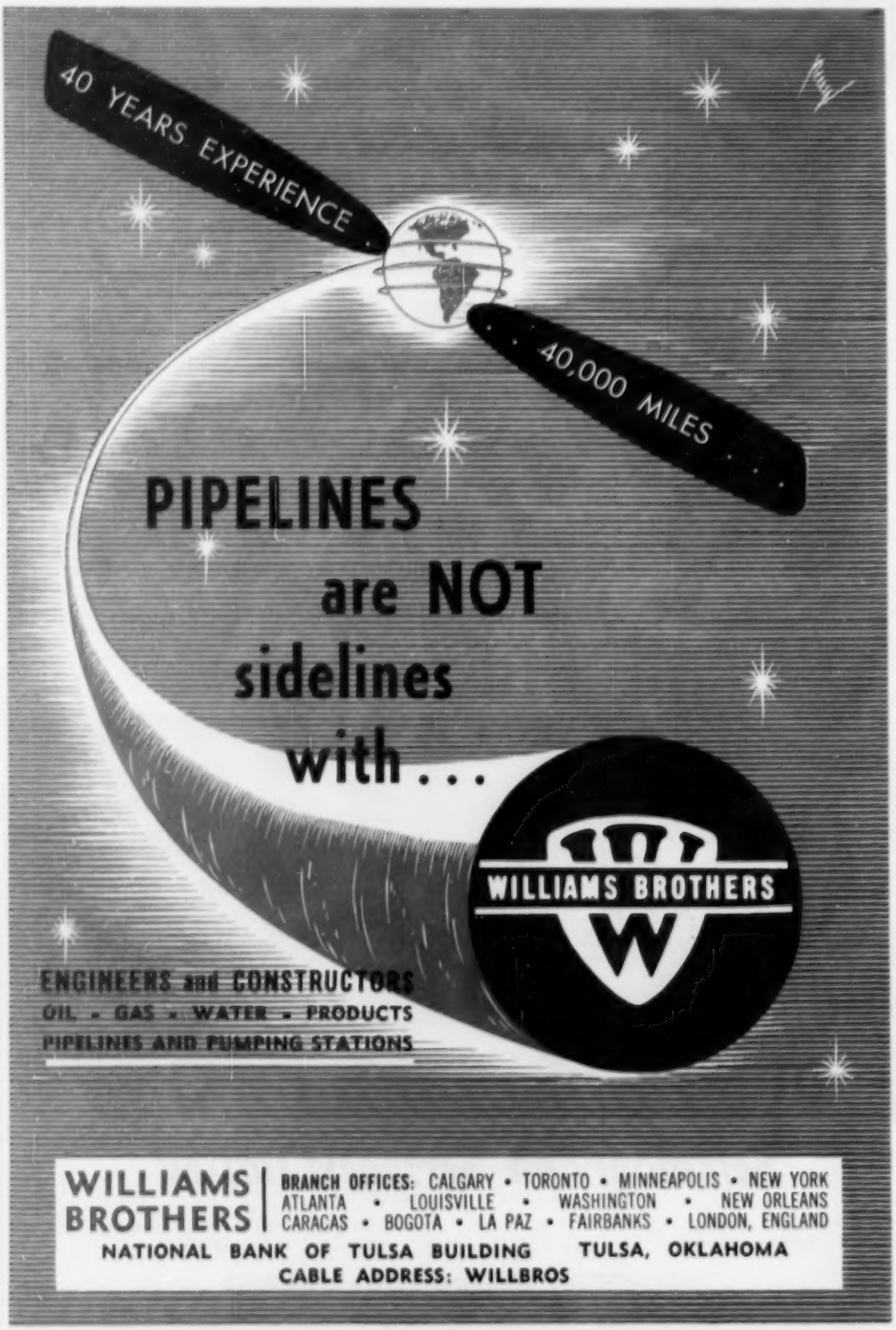
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MER is lower, it permits a return of capital at an economic rate although it may shorten the ultimate recovery of the well. Otherwise the well might never cover its operating costs.

The economic allowable is a fact which sets a floor under most Crown reserve sale bids; the market outlook is a matter of judgment which should determine the ceiling the operator is prepared to place on its bid. The early February sale illustrates current thinking.

In this sale, well-located quarter sections of four wellsites in the Joffre Viking sand field, where average development cost is $32,000 per well, but maximum economic allowable is 37 barrels per day (because of reservoir deficiency), brought top bids of $45,000 cash bonus for leases offsetting production on two sides. Other parcels half a mile to a mile from production brought only $20,000 to $30,000 per quarter. Parcels in Fenn-Big Valley, a limestone field in the Devonian coral reef, with average development cost of $65,000 per well on 40-acre spacing and minimum economic allowable of 42 barrels per day, but probable long-term average of 60 to 70 barrels per day, brought as much as $500,000 offsetting production on two sides along the trend. Flank acreage offset on one side by production attracted bids of $126,000 and $210,000 per quarter. Prices paid for similar parcels a year or two ago were 50 to 100 percent higher.

The most recent Pembina Crown reserve sale resulted in drastic lowering of bids which for similar parcels in sales last year ran over $500,000 per quarter. Prices at the latest Pembina sale, held October 19, 1954, ranged from a high of $250,000 per quarter to a low of $78,800.

The effect of production rates and field prices cannot be exaggerated, as companies have generally come to realize that a valuation based on "oil in the ground" takes account of only a minor factor in the complex structure of present operation. Alberta, with its domination of producing operations in western Canada, has always suffered immediately the effect of tightening of markets. This is reflected in a long-term downward trend of both production rates and prices. Current prices at wellhead are the lowest in the western hemisphere, according to a recent comparison drawn by W. O. Twaits, vice president of Imperial Oil Ltd. The following tabulation of per well allowables in the major fields over the past four months is symptomatic of the trend, with average daily production tending to drift downward toward the economic allowable:

FIELD	MAR.	FEB.	JAN.	DEC.
Bonnie Glen	141	159	171	172
Fenn-Big Valley	71	77	81	81
Leduc-Woodbend D3	67	70	70	70
Pembina	105	117	125	126
Redwater	80	89	94	94
Westerose	237	273	297	299
Wizard Lake	193	221	240	241

In January, it should be noted, the Alberta allowable was the highest in history, while in both February and March it was almost equal, at only one percent below December. The drastic reduction in individual allowables illustrates the impact of large-scale development of just the Pembina field and draws attention to the problem of selection of a field in which to initiate development operations, as well as the conservative basis on which investment in older fields, such as Redwater or Leduc, should have been made to allow for this eventuality. Field prices in Alberta at present average $2.58 for crude of Redwater quality (34°API), 22 cents under comparable crude in the Rocky Mountain, Mid-Continent and Gulf Coast regions, and 63 cents under California.

Royalty on Crown leases has been on a square root of average daily production basis since May 1951, and has met with acceptance and approval by the operators who feel that it is the fairest method of assisting wells with low potential and those which are handicapped by lack of market. The maximum royalty rate is 16 2/3 percent, but, as can be seen from the table of production allowables, no wells are currently paying the maximum.

Saskatchewan also uses the square root royalty, with a maximum of 15 percent, but Manitoba has retained the old standard flat rate of 12½ percent.

Overhead expense is an important factor in all operations, regardless of the size of the operator, but in general only a large company can afford to keep a full staff of geological and engineering experts and build up its own exclusive information and records. Several consultant firms of geologists and reservoir engineers offer service on a fee basis, designed particularly for the use of smaller or non-integrated companies. This information, of course, is not usually exclusive, but in most cases its value to the company buying it is far beyond the cost, while the cost is a great deal less than would be involved in developing the information from primary sources.

The University of Alberta has been very progressive in establishing courses in petroleum engineering and petroleum geology, by means of which there has been built up an increasing group of graduates trained specifically to fill technical positions. Office and management costs can be considered moderate, including the cost of building or renting property.

The requirements for financing a Canadian subsidiary in Canada, as far as they concern the securities commissions of the various provinces, are much more realistic and co-operative than those of the SEC in the United States, although they provide fully as much protection to the investor. Full disclosure of all operating facts and of the intended land acquisition structure will satisfy most of the security regulations. In setting up its financial foundation, a balance

(Continued on page 160)

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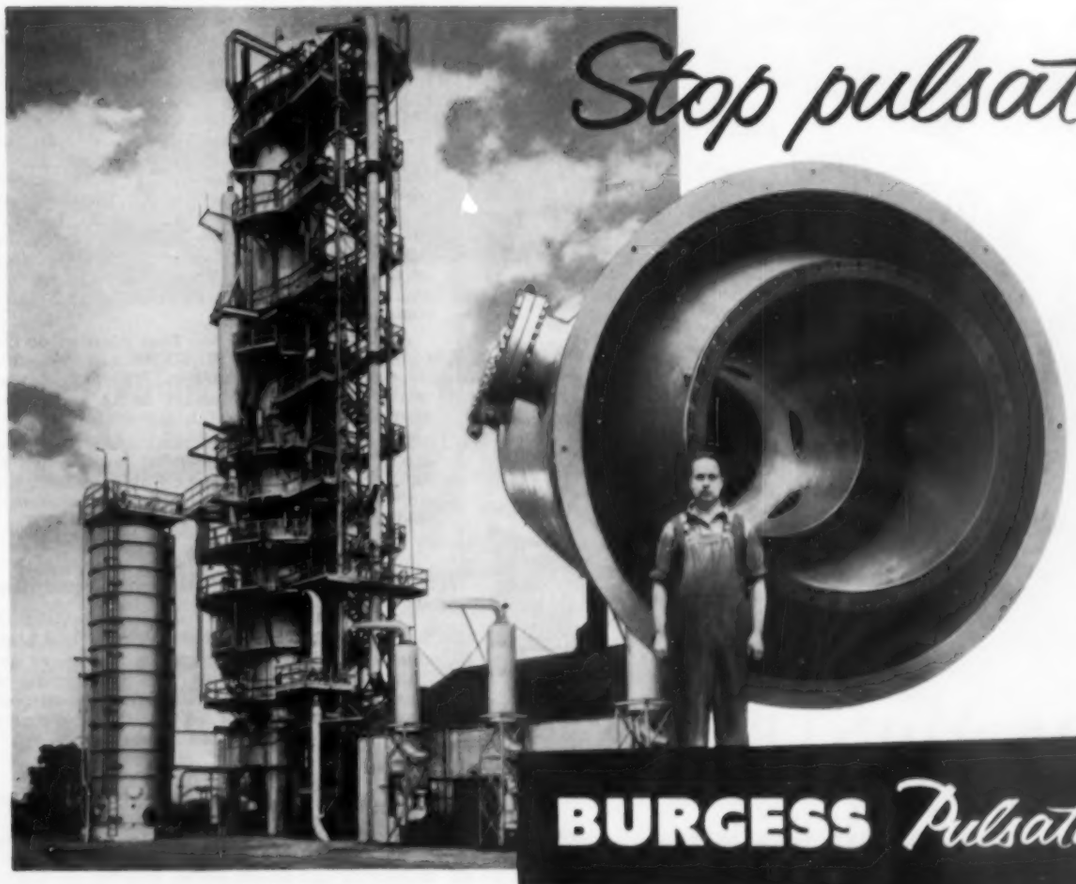

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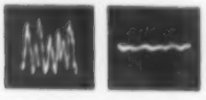

Oscilloscope recording shows pulsation (left) and smooth flow attained after fitting BURGESS Snubber (right).

BURGESS *Pulsation Snubbers*

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How to Operate in Canada

(Continued from page 158)

has to be struck between fixed income securities and equity portion. This is of particular importance to a smaller type of company which cannot afford long-term commitments on fixed-interest obligations.

Taxation laws in Canada are comparatively simple. In all the oil producing provinces, the federal government is the only taxing authority as far as income tax is concerned. Provincial governments impose only mineral taxes, which are reasonable in their incidence provided a company is not trying to carry an excessive amount of property without doing work on it.

Obviously the whole structure of Canadian income tax cannot be covered in this survey, but in brief the important features of the tax law are the inclusion of a depletion allowance in addition to depreciation, the provision for carrying losses forward over a five-year period and carrying back future losses for one year, and a special provision applicable to the oil industry under which all costs of exploration and exploratory drilling, under an approved program which the dominion finance minister considers will contribute substantially to knowledge of new regions, are deductible in full. This provision, which came into effect in 1951, is currently in effect to the end of 1955 and there is considerable hope that it will be extended at the current session of Parliament.

The depletion allowance is a very generous one-third of all net profits for the taxation year "reasonably attributable to the production of an oil or gas well." It is a continuing allowance, not related in any way to the capital cost of the properties, and is computed on the profit remaining after deduction of exploration and development allowances and providing for depreciation of fixed assets at the rate of 20 percent for furniture, fixtures and machinery or 30 percent for drilling rigs and equipment, vehicles and surface producing installations.

The general tax rate on corporations is a fixed rate of 52 percent on all net income above the first $10,000, which is taxed at 22 percent. Thus a small company, earning a very small net, can get by with a relatively light tax burden. Large companies can lighten their tax load by conducting exploration and wildcat programs which entitle them to the special write-offs. The advantage of dealing with only one taxing authority is also conducive to efficiency.

The Canadian scene in the mature phase which it has reached in 1955 still presents many challenges to the imaginative and aggressive operator, although they are a different type from those which were presented to the operator of 1948 or 1949. The big problems now are selection of the areas in which to conduct wildcat and development programs respectively, and the considerations of weighing bids on Crown reserve acreage or private acquisition of producing property against the probable future trend of prices and production allowables. Each province has its own large-scale problems: in Alberta the restrictions imposed by excess producibility of acceptable crude; in Saskatchewan the limitations on market for the typically lower-grade crude, compelling operators to create new lines of transportation and new refining facilities outside the area; in Manitoba the technical obstacles of peculiar action of wells under normal kinds of acidizing and fracturing treatments; in British Columbia the uncertain future of natural gas production and the potential wellhead price.

Careful study of conditions, however, and judicious selection of both the type of operation and the area for it, will make it possible for a company entering the Canadian oil play even at this stage of maturity to use its imagination and resources for exploitation which will return financial as well as technical profit.

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Here is Canada's spectacular record in oil and gas . . . 17 new discoveries in 1947—182 new discoveries in 1954! 150 million barrels of proven reserves in Canada in 1947—2½ billion barrels in 1954!
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—While the Bank is prepared to provide all available information on the oil industry, it does not make recommendations regarding the purchase of individual oil stocks.
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Dresser Reports Banner Year

A record both in sales volume and net earnings was established in the year ending October 1954 by Dresser Industries, manufacturers of petroleum and chemical equipment. A report issued to stockholders by President H. N. Mallon showed net earnings of $7,362,891, equivalent to $5.53 per share. This compares with net of $5.31 earned in 1953. In the year just ended there was a non-recurring profit item of about $611,000, but even after exclusion of this, the operating income was the highest ever obtained by the present group of Dresser companies.

At the end of 1954 the cash position of the company had risen to $21,472,000, nearly double its amount a year earlier. Working capital increased $4,000,000 and net worth on a common share basis rose ten percent.

Increased earnings and continued strengthening of the company's financial position led to an increase in the quarterly dividend on the common shares of the company, placing that stock on a $2 yearly basis.

Stone & Webster Chicago Appointee

Franklin C. MacKrell, a vice president of Stone & Webster Engineering Corp., has been appointed district manager in charge of its Chicago office, following the retirement of Louis H. G. Bouscaren, who had held that post for 33 years and had served the Stone & Webster organization for more than 50 years.

Catalytic Engages Powell Group

Catalytic Construction Co. has engaged the Sheppard T. Powell Organization of Baltimore, Maryland, as consultants to supplement Catalytic's engineering and technical staffs in solving water problems that arise in the design, engineering and construction of new plants.

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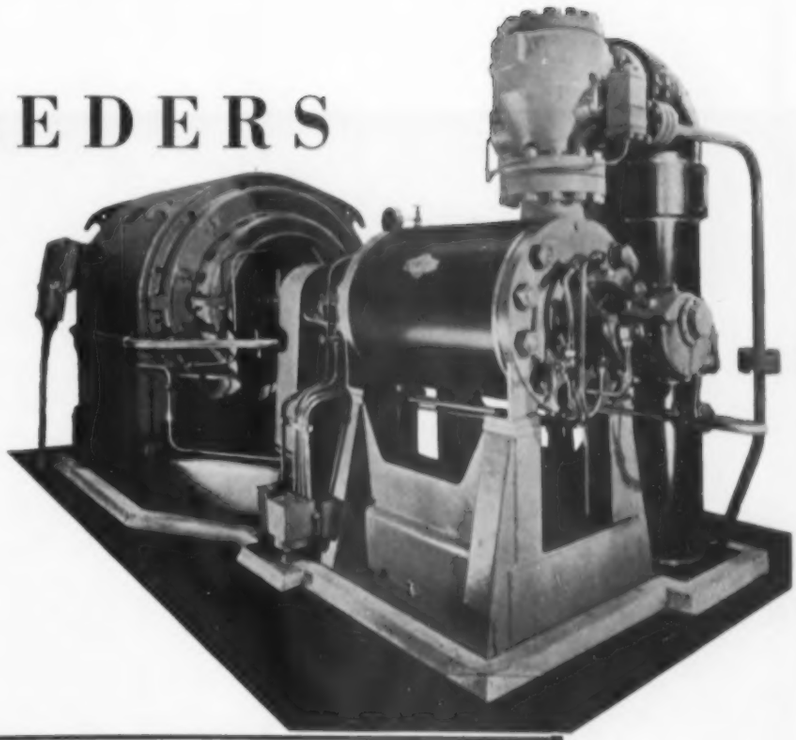

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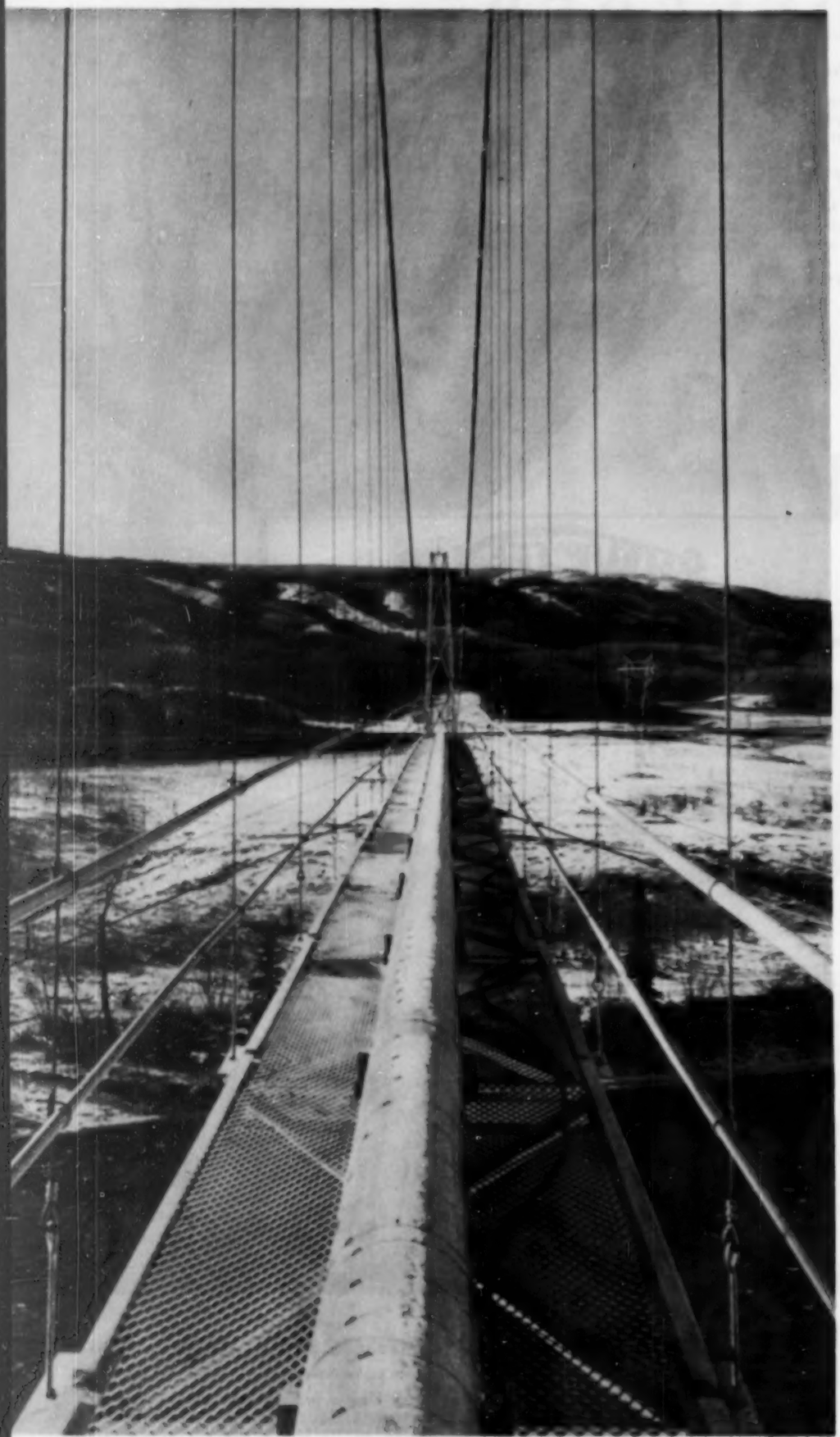

Shell's pipe line suspension bridge crosses the Bow River west of Cochrane, Alberta to tie in with the gathering system in the major part of the Jumping Pound gas field south of the river. The bridge has a 655-foot clear span between towers and an overall length between anchors of 1,120 feet. It carries an 8-inch pipe line which transports 16 million cubic feet of gas per day.

CANADIAN PIPE LINES

Era of major gas line expansion may begin this year with first work on 30-inch Westcoast Transmission line.

CANADIAN PIPE LINE investment is approaching a half billion dollars, most of which has been spent in the past five years since work first was begun on the Interprovincial system. With work about to start on the first major gas line and additional crude lines required, the next few years will continue active. Average annual investment rate in the next five years is expected to be $100 million or more.

First major gas pipe line construction will be Westcoast Transmission Company's 650-mile line from the Peace River-Fort St. John area to Vancouver and the U. S. border where it will deliver gas to the Pacific Northwest Pipeline Corp. system. Not every roadblock has been removed in the path of the Westcoast line, but it appears nearer the construction stage than does the ambitious $300 million Trans-Canada Alberta-Montreal line. Westcoast has its gas supply under contract and has sold 300-400 million cubic feet per day to United States interests. Financing arrangements for the $120 million line have been made. As the result of the peaceful settlement of the former bitter rivalry for gas markets in the Pacific Northwest, it is believed that Federal Power Commission approval will not be delayed unduly and completion by 1957 will be achieved. A

(Continued on page 164)

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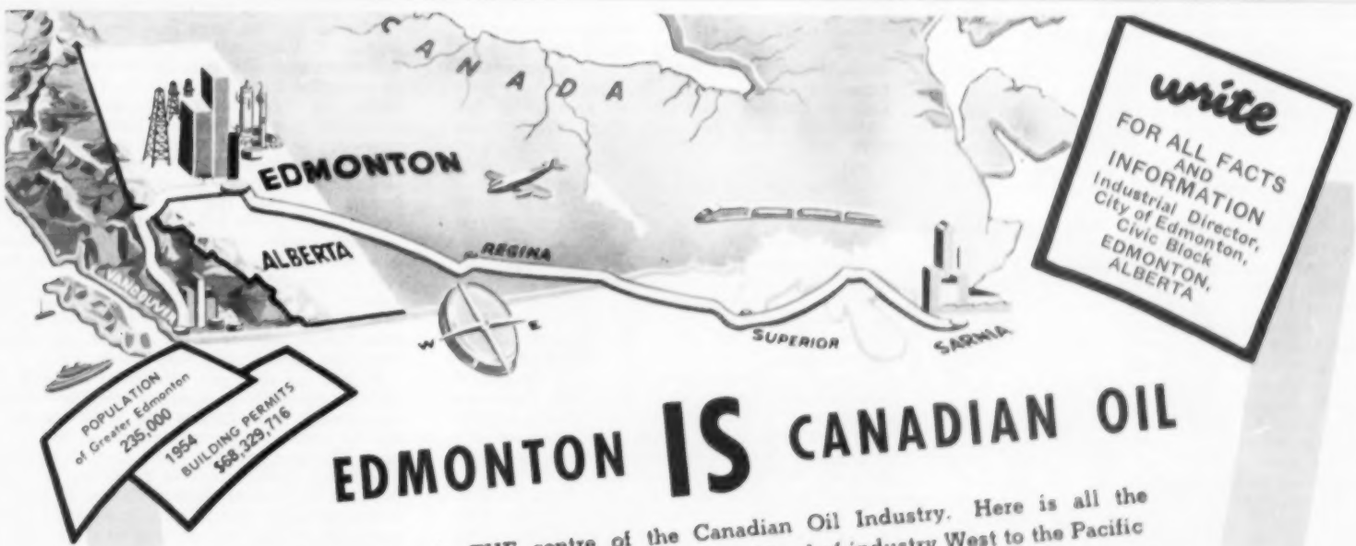

EDMONTON IS CANADIAN OIL

Yes, Edmonton is THE centre of the Canadian Oil Industry. Here is all the bustling activity of pipelines carrying the lifeblood of industry West to the Pacific Coast and East to Superior and Sarnia . . . of multi-million dollar refineries . . . of petro-chemical giants . . . and of a multitude of secondary industries. Small wonder Edmonton leads Canada in population gains, building permits and general expansion. It's a steady, healthy growth based on a sound economic outlook. Edmonton is the centre of the population trend Northward—the hub of the population density of Alberta. Get all the facts on this amazing city today!

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CAPITAL CITY OF ALBERTA
EDMONTON
Manufacturing and Distributing Centre

Canadian Pipe Lines

(Continued from page 162)

detailed report on this line will be found elsewhere in this issue.

Trans-Canada Pipe Lines Ltd. still has many important matters to settle before actual construction can get under way. Managers of the project have been working on numerous fronts. It has been necessary to purchase gas in the west while selling activity was in progress in the east and in the Minneapolis-St. Paul area in the United States. Negotiations have been conducted with the U.S. Federal Power Commission and with various Provincial and Dominion authorities in Canada.

The pressure of Western Canada crude seeking new markets caused most of the pipe line construction work in 1954 and will continue to be an important factor this year. Trunk line extensions to two new refineries in the United States will add 75,000 barrels of potential new outlet for Prairie crude before the end of 1955. Trans Mountain Oil Pipe Line will extend its U.S. delivery system to Anacortes, Wash. to serve Shell Oil Company's new 50,000 b/d refinery when it is ready to begin operations late in the year. Shell has indicated that it will process Canadian crude.

In the Midwest, a 16-inch line will be laid from Clearbrook, Minn., to the Minneapolis-St. Paul area to deliver Saskatchewan crude to Great Northern Oil Company's new 25,000 b/d refinery. Completion of the line is planned to permit deliveries in June.

First leg of the system was put into operation in January by the South Saskatchewan Pipe Line Co. The 154-mile South Saskatchewan line was laid at a cost of $10 million to deliver crude from Fosterton, Cantuar and Success fields to the Interprovincial pipe line at Regina. The 16-inch line will have an initial capacity of 20,000 b/d which can be increased by the installation of another pump station. The line can deliver oil to the two small refineries now operating at Moose Jaw which heretofore have had to rely on rail and truck inshipments. The Moose Jaw Refineries Ltd. plant has a capacity of 2,000 b/d and the National Power and Light skimming plant can run 1,000 b/d.

At Regina, South Saskatchewan has arranged to make deliveries to Consumer's Cooperative Refineries Ltd. A short 10-inch spur line serves the Regina field. The Coop. plant can use only limited quantities of the 21-24 gravity Fosterton crude.

The South Saskatchewan line is owned by three oil companies: Socony-Vacuum Oil Co. of Canada, Woodley Canadian Oil Co. and Southern Production Co., Inc. The three are partners in the Fosterton, Cantuar and Success fields and Socony-Vacuum is the operator. Fosterton was discovered in 1952, but it was necessary to drill enough wells to indicate the magnitude of reserves before spending $10 million on a pipe line outlet.

The oil to be handled is medium gravity with a pour point of 5°F. Oversize pumps and prime movers have been installed by both South Saskatchewan and Interprovincial to move the oil. Emulsion is being broken by Petreco treaters. Tankage totaling 160,000 barrels has been built at the South Saskatchewan pump station and three 55's have been erected at Regina.

Although the Minnesota line is entirely in the United States, it must be considered, in effect, a part of the Canadian system as is the Lakehead Pipe Line Co. line which extends Interprovincial deliveries to Sarnia, Ont., through Wisconsin and Michigan. The Minnesota line is owned by Woodley, Southern Production and J. Howard Marshall of Fort Worth. It will consist of 260 miles of 16-inch pipe. Crude will be delivered to the Great Northern Oil Co. refinery at St. Paul.

Another Saskatchewan line which went into service early this year is the 30-mile crude line of Mid-Saskatchewan Pipe Lines Ltd. which connects the Smiley field with Interprovincial at Ermine, Sask. The line is wholly owned by Royalite Oil Co. Ltd. Head offices are at Regina under the direction of Charles Hay, president. The line consists of a field gathering system to feed 15 miles of 6-inch line from Smiley to the Coleville field and 15 miles of 8-inch from Coleville to Ermine. The Eureka field is to be served also. Capacity can be raised to 15,000 b/d if production warrants. Initial throughput was 3,200 b/d.

Late in 1954 the Virden field in Manitoba was given a pipe line outlet by Trans-Prairie Pipelines Ltd. Deliveries to Interprovincial at Cromer station were begun December 15 at the rate of 8,000 b/d. Trans Prairie laid 13 miles of 6-inch main line and smaller diameter laterals to Virden-Roselea and North Virden-Roselea fields.

Late in the year it was announced that a 450-mile propane line will be built from the Tioga field in North Dakota to Winnipeg, Man. The line is planned to take care of peak load requirements of the Winnipeg Central Gas Co. after the Trans-Canada gas line is laid. The company now imports propane from Oklahoma by tank car. The line will have a diameter of four to eight inches and will cost about $20 million. Completion in 1955 is contemplated. Supply source would be the Signal Oil and Gas Co. plant at Tioga-Brandon and other way points would be served as well as Winnipeg.

Most important crude gathering system begun during the past year was the Pembina pipe line which provided an outlet for crude from that rapidly growing field late in November. The 72-mile, 16-inch line connects the field with both the Trans Mountain and Interprovincial systems at Edmonton. With one pump station the line can handle 115,000 b/d of Pembina crude and with one booster station the throughput can be enlarged to 150,000 b/d. Operator of the line is Pembina Pipe Line Ltd. which recently sold various stocks and bonds totaling $12.5 million to finance the project. Total construction cost of the system by 1958-59 is estimated at $14.2 million. Of this, $11.9 million will be spent by the end of 1956. Outstanding capitalization at present is $7.5 million, 4.25 to 4.75 percent first mortgage bonds; $2 million 5 percent debentures; $2 million, 5 percent preferred stock and 400,000 $5 common shares.

Eventually the gathering system may require 200 to 400 miles of line. Two engineering firms made studies of the Pembina field to determine pipe line requirements. Trafford & Associates Ltd. of Calgary estimated an average of 256 well completions per year from 1956 through 1965 and a total eventually of 3,200 wells in a producing area of about 254,000 acres. Recoverable reserves were estimated at 890 million barrels. Production in 1955 was placed at 20,400 b/d, 55,700 b/d in 1956 and a peak of 190,000 b/d in 1960.

DeGolyer and MacNaughton of Dallas estimated that 3,000 wells would be required to develop the field and suggested a producing area of 240,000 acres. Production was estimated at 23,200 b/d in 1955, 49,200 b/d in 1956 and an average output of 50,100 b/d through 1976. Recoverable reserves were placed in excess of 400 million barrels. Most Canadian observers estimated Pembina reserves to be nearly double the DeGolyer firm's figure. It is pointed out that although fracturing is necessary the wells hold up well after final completion.

Prior to completion of the new line, the cost of trucking crude to Edmonton was about $1 per barrel. An initial tariff of 25 cents per barrel was announced but this now has been reduced to 19 cents since volume handled has risen above 20,000 b/d.

In the Sturgeon Lake area northwest of Edmonton, very substantial crude reserves have been developed within the past year. Peace River Pipe Line Co. Ltd. has been granted permission to build a crude line to this district. Plan is to lay a 16-inch line from Sturgeon Lake to Iosegun Lake and a 12-inch line from Iosegun Lake to Edson, where it will connect with the Trans Mountain pipe line. At some later date a branch may be laid from Iosegun Lake to Edmonton so that deliveries can be made to the Interprovincial system or to local refineries. Maximum capacity of the line is to be 57,600 b/d.

Peace River Pipe Line Co. Ltd. was organized by a group of six oil companies: Amerada Petroleum Corp., Canadian Gulf Oil Co., Hudson's Bay Oil & Gas Co. Ltd., Imperial Oil Ltd., Shell Oil Co., and Union Oil Co. of Calif. Canadian Gulf will be the operator.

Business for Trans Mountain Oil Pipe Line Co. has been improving in recent months as Canadian crude became more competitive with Middle East and Latin American Oil at Pacific Coast refineries. General Petroleum Corp. recently increased its purchases of Canadian crude with the result that December Trans Mountain runs reached 62,525 b/d compared with an average of only 39,787 b/d for the year.

Trans Mountain now is preparing to serve Shell's large new refinery under construction at Anacortes, Wash. Extensions to Anacortes involve laying 27.5 miles of 20-inch main line from Laurel to Burlington plus nine miles of 16-inch lateral. Cost of the job is about $2,750,000. In 1954 Trans Mountain laid 15.4 miles of 20-inch main line from the Canadian border to Burlington, Wash., plus 11.6 miles of 16-inch later to Ferndale.

Largest construction job of 1954 was the looping done by Interprovincial to increase its capacity east to Superior, Wis. The company spent $51 million in 1954 to install 455 miles of 24-inch loop in Canada and 196 miles of 26-inch loop in the United States. Five pumping stations in Canada and three in the United States were expanded. A completely new station was built at Saxon, Wis., on the 30-inch Lakehead extension. New tankage erected totaled 862,000 barrels.

With the recent looping and pumping facilities completed, Interprovincial now has a capacity of 217,000 b/d from Edmonton to Regina, 193,000 b/d from Regina to Gretna, 163,000 b/d from Gretna to Superior and 147,000 b/d from Superior to Sarnia.

Interprovincial now has an investment of $224 million in its 1,750-mile system from Edmonton to Sarnia. Crude handled has increased year by year as extensions and new loops were built. In the first full year of operation, 1951, Interprovincial pumped 31 million barrels. This increased to 42 million in 1952, 54 million in 1953 and to 68 million barrels last year.

This year is the first since Interprovincial was organized that no large new project is contemplated. The lull will not be of long duration, however. In 1956 it is believed that the line will be extended from Sarnia to the Toronto area to serve the Trinidad Leaseholds and British-American plants. Trinidad Leaseholds finds it necessary to enlarge its plant and does not wish to go to the expense of installing enough tankage to provide a crude supply during the winter freeze. By 1955 the Toronto market should reach about 40,000 b/d, which would justify the 195-mile extension from Sarnia. There has been considerable talk of extending the line to Montreal to top the 200,000 b/d market already developed at that point, but it is not believed that this 440-mile extension will be justified in the near future because of the competition of Latin American and Middle East crude.

Within the past year Montreal refiners owning the Portland-Montreal crude line increased its capacity from 158,000 b/d to 190,000 b/d by adding four new pump stations on the 18-inch line. The line now has eight operating stations. Additional capacity can be given the system by building four more stations on the 12-inch line which parallels the 18-inch line. This may be necessary before long in view of the added still capacity being built at Montreal.

In 1954 the Montreal line handled 146,091 b/d of crude. Maximum capacity of the line at present is 190,000 b/d. Added refinery construction at Montreal will force further expansion or an increase in tanker inshipments up the St. Lawrence.

Canadian lines as a whole increased their traffic materially in 1954. Deliveries totaled 172 million barrels compared with 147 million barrels in 1953, a rise of 17 percent. Trunk lines handled 619,458 b/d in December. Barrel-miles totaled 5,881 million and the average haul was 306.2 miles.

Canadian pipe lines employ 1,185 persons.

Operating revenues of all lines in 1954 totaled $42 million compared with $28 million in 1953, an increase of almost 50 percent.

Large increases in traffic and revenue are anticipated in 1955.

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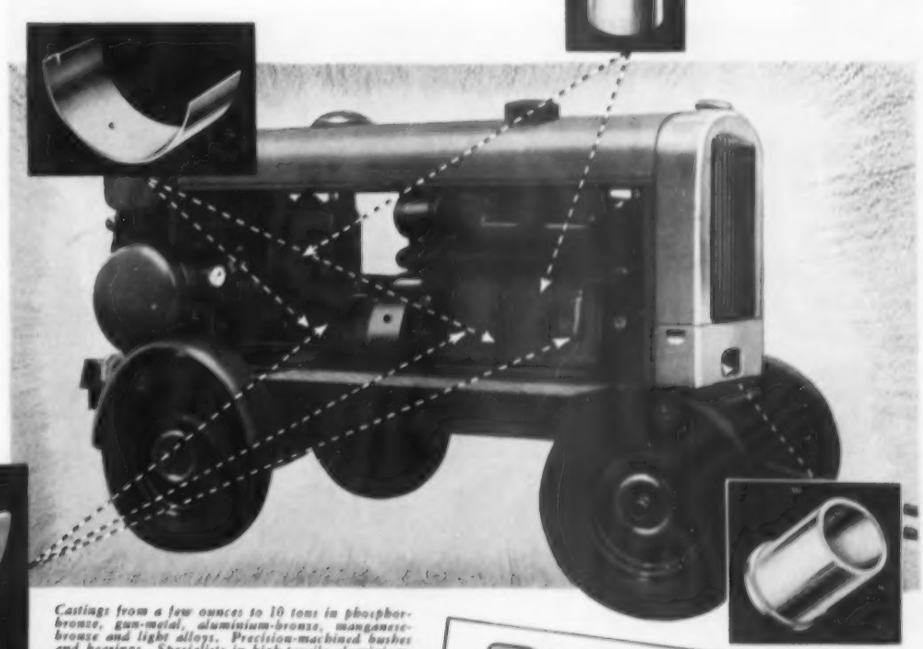

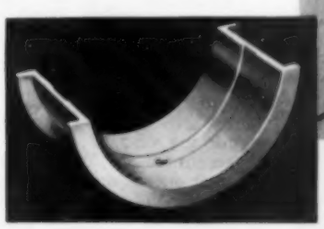

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Saskatchewan — 1954

(Continued from page 76)

this group to participate in a great many of Saskatchewan's spotty oil plays.

Those companies which recorded a single oil discovery during 1954 included Sooner Petroleums, Alminex Ltd., Husky Oil & Refining Co. Ltd., The Sohio Petroleum Co. group, Canadian Delhi Oil Co., and Dome Exploration (Western) Ltd.

Sooner-Gill 3-8, Lsd 3-8-7-10 W2 (reference 19), was put on production February 20. Located in the general Midale area, this Gill 3-8 well is producing 31.5° oil from the Mission Canyon section of the Mississippian, some 4,450 feet deep.

Alminex Ltd. completed, on March 14, Alminex-Crystal 4-15, Lsd 4-15-30-27 W3 (reference 20), a light gravity oil well. About six miles southwest of Viking oil-wells in the Dewar section of the Smiley field, Alminex-Crystal 4-15 is producing from the Viking sand.

Husky-Phillips-St. Florence "A" 10-19, Lsd 10-19-30-24 W3 (reference 21), a June discovery, recovered 30° gravity oil from the Viking at some 2,240 feet. This well is located to the southeast of the Smiley field.

The Husky-Phillips team also made two commercial gas discoveries. The first of these, Phillips-Husky-Eastside 1, Lsd 13-14-29-29 W3, (reference 22), rated an open flow of 1,780 mcf of gas per day from the Viking sand. Phillips-Husky-Verendrye 1, Lsd 1-19-28-23 W3 (reference 23), was a Banff sand find and established an open flow of 1,020 mcf of gas per day through perforations between 2,914 feet and 2,920 feet.

The next oil discovery was brought into production on August 5 by the Sohio Petroleums Ltd. group. Rated at an initial potential of 33 barrels of 24.6 gravity oil per day, Sohio-North Wapella 13-13, Lsd 13-13-15-1 W2 (reference 24), is flowing from the upper Shaunavon at approximately 2,225 feet.

Delhi-Husky-Phillips-Richfield-Bone Creek 1, Lsd 6-34-10-19 W3 (reference 25), in the general Swift Current area, was brought into production as a medium gravity oil find on October 19. The well has rated an initial potential of 180 barrels of 24.5° oil per day, flowing from the J-2A of the Jurassic. Top of the J-2A on this well was contacted at 4,392 feet.

Dome Exploration (Western) Ltd. was the operator of Saskatchewan's twenty-first commercial oil discovery of the year. Dome-Harris-Cox-Imperial-West Midale 9-27, Lsd 9-27-6-11 W2 (reference 26), close to the International Boundary in southeast Saskatchewan, was successfully completed in the Charles zone of the Mississippian. During the drillstem test from about 4,550 feet, pipe recovery consisted of 1,890 feet of frothy, gassified oil.

The Canada Southern group accounted for two gas discoveries during 1954, both in the Coleville-Hoosier area. Canada Southern-Hoosier 6-31, Lsd 6-31-31-27 W3 (reference 27), flowed gas at a maximum rate of 4,000 mcf per day on a drillstem test from the Viking at approximately 2,380 feet. The group's other gas strike, Canso Oil Producers-New Superior-Hopedale 6-30, Lsd 6-30-31-22 W3 (reference 28), is a Viking well also. On drillstem test it flowed gas at the rate of 1.2 mmcf per day from about 2,260 feet. Bata Petroleums is credited with a Viking sand gas discovery made early in April in the Unity area of Saskatchewan. Bata B-3-24, Lsd 3-24-39-23 W3, (reference 29), contacted the Viking at 1,660 feet and established eight feet of effective pay rating an open flow of 19,600 mcf of gas per day.

The exploratory drilling program carried out by those companies previously mentioned resulted in 220 dry holes and 28 discovery wells during 1954. A tabulation of Saskatchewan discoveries is given elsewhere in this issue.

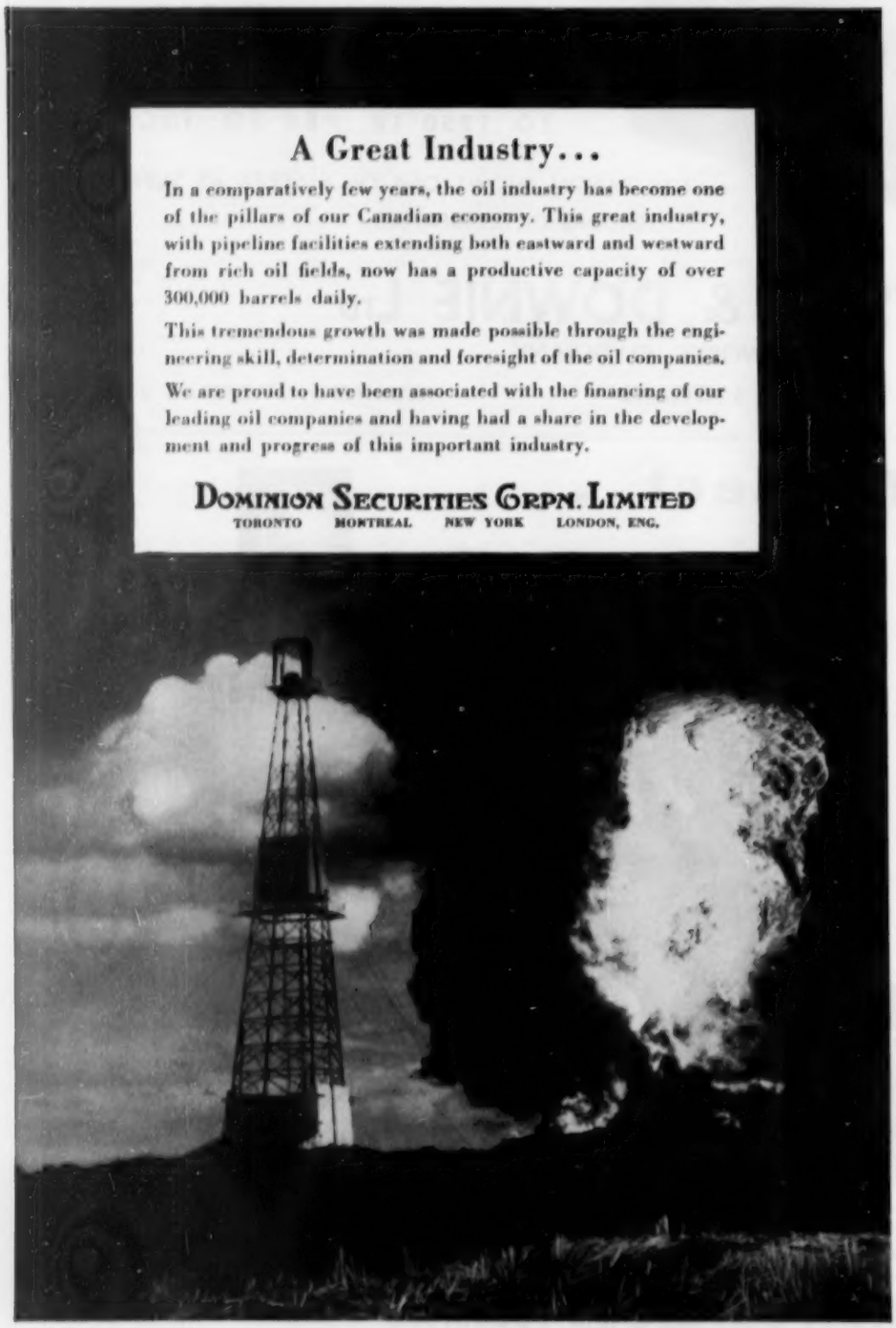
The number of geophysical parties actually operating in Saskatchewan at the end of 1954 totalled 27, made up of 25 seismic and two gravity meter crews. The first eight months of the year showed a constant increase in the number of active parties; up 25 over 1953's year end total of 20. October, November and December, however, saw a total of 18 crews withdraw from the field, resulting in a net increase for the year over December 1953, of seven active parties.

The heaviest influx of parties in Saskatchewan took place during the early spring and summer months and there was a corresponding decrease in activity in Alberta. At the end of September 1954, there were 38 fewer parties in the field in Alberta than at 1953 year's end. The greatest part of this geophysical swing of activity can be attributed to the extremely wet summer experienced in Alberta. Development in Pembina, Canada's "hottest" oil area, was slowed almost to a complete standstill because of the muskeg conditions blanketing that area. Freeze-up, starting late in October, enabled work to recommence in those areas made inaccessible by 1954's unusually heavy rainfall.

Gross value of crude oil to producers totalled $8,328,385, an average price of $1.58 per barrel, for a total 12 months' output of 5,255,614 barrels. Production of natural gas for that same period totalled 4,958,079 mcf, having a gross value of $266,897, an average well head price of 5¼ cents per thousand cubic feet.

Saskatchewan's Coleville-Smiley field contributed a total of 1,985,372 barrels of light oil towards that province's net crude production for the year. Production from this area alone accounted for 37.75 percent of Saskatchewan's total output and was more than twice the production of its runner-up, the Lloydminster heavy oil field. Cumulative production from this field totalled 892,683 barrels of oil. The other areas which contributed substantially towards the province's crude output are as follows: Lone Rock, 692,077 barrels; Gull Lake, 327,789 barrels; Success, 337,992 barrels; and Wapella, 216,215 barrels. Together these six

(Continued on page 168)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Saskatchewan — 1954

(Continued from page 166)

fields accounted for approximately 85 percent of crude produced for the full year 1954.

Production of natural gas to the end of December more than tripled compared with that same period one year ago. The Brock, Coleville and Unity fields continued to dominate the gas scene, with that group accounting for 79 percent of 1954's production of 4,958,079 mcf of gas, as compared with 74 percent of 1953's 1,620,478 mcf.

It should be noted that proven reserves of natural gas in Saskatchewan are not large; they are not adequate to supply the needs of the province at this time. As it now stands, the proposed Trans-Canada pipe line, which will carry gas from Alberta fields, will be called upon to serve southern Saskatchewan communities, including Swift Current, Moose Jaw and Regina.

The distribution of propane gas and propane appliances is a relatively recent phase of the Saskatchewan petroleum industry. Propane appears to be the most suitable fuel to meet the needs of that province's large and widespread rural population. There are still great distances between centers of population and there are still many areas not served by rural electrification.

In the past nine years, Hugh Gas Ltd., a wholly owned subsidiary of International Utilities Corp. and Saskatchewan's largest distributor of propane gas and appliances, has opened nine bulk plants and retail stores. As a further aid to growth, dealers have been established at 11 additional points throughout the province. At year's end, Winnipeg & Central Gas Co. and Regas Ltd. of Regina were the only other propane companies operating in Saskatchewan, both with healthy growth records.

Seventy percent of the petroleum and natural gas rights in Saskatchewan are estimated to be held by the government, the balance being freehold land held mainly by the Hudson's Bay Co. and the Canadian Pacific Railway Co. At the present time private operators can acquire these petroleum and natural gas rights by one of two methods.

When bidding for a specific parcel of land, bidders may submit a cash bonus for an outright purchase, subject to the usual government royalty, or they may enter into a net royalty lease agreement with the government. Tendering an offer of cash for land is a relatively straightforward procedure, but the net royalty lease is novel in the oil industry and may best be described by referring to the government's most recent land sale.

On February 21, 1955, 11 parcels of Crown reserve proved and semi-proved acreage in the Cantuar and Dollard medium gravity oil fields were offered to the public. On one parcel of 640 acres, a $20,138 cash bonus bid was accepted. On one other section, decision was deferred and on a third, all bids were rejected. The remaining eight parcels attracted net royalty bids ranging from 30 percent for one section to a high of 77.3 percent for another section.

There is no cash payment involved when tendering on a net royalty petroleum and natural gas lease. During payout on a producing property, the Crown collects a minimum of 12.5 percent of production. After payout, when development and producing costs have been fully recovered, proceeds are subject to the usual Crown royalty. In addition, the percentage of net royalty as bid by the lessee is applied against the net proceeds of production every year and paid to the Crown. The balance of net proceeds remaining is the property of the lessee.

This most recent form of government participation in the oil industry is an improvement over and a slight modification of the March 1954 agreement with Consumers' Co-Operative Refineries Ltd. Here, the Saskatchewan government farmed out two sections of Crown reserve lease acreage in the Smiley field. The co-operative was charged with paying all development costs and during payout was to receive 85 percent of net production, after paying normal Crown royalty. The remaining 15 percent was the government's share.

After payout period the government is entitled to 60 percent of the net return and the co-operative 40 percent.

Acknowledgement: the author is indebted to G. D. Kilbourn, statistician for Trafford & Associates Ltd., who collected and tabulated most of the material for the above article.

New Low Frequency Seismic Refraction System

A new very low frequency seismic refraction system, with special amplifiers linear from one to 50 cycles and unique refraction seismometers with a natural frequency of two cycles per second, has been announced by Houston Technical Laboratories.

The refraction method of seismic exploration has been limited in the past by the inability of instruments to record low frequency energy. With the new VLF system, low frequencies are easily recorded, resulting in wider and deeper probing of subsurface conditions. High system sensitivity also permits the use of much smaller powder charges, reducing surface damage. Well-defined first breaks have been received at five miles from a five pound charge.

The VLF system already is being applied to determine the thickness of sediments in large basins, to study the sedimentary column above massive Paleozoic sediments and to determine geologic structure in areas where the reflection method is inefficient. Due to its very low frequency response and good signal-to-noise ratio, the VLF system is also uniquely suited to the delineation of salt domes in offshore waters.

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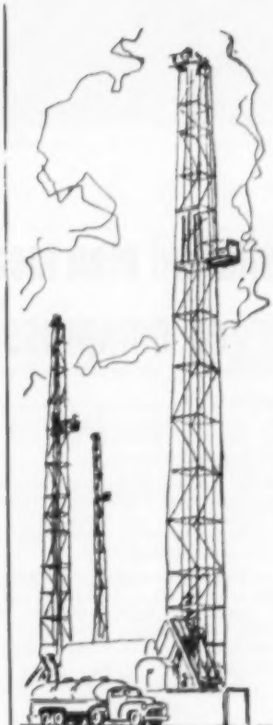

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Rocky Mountain Year Book

"Stability was introduced to the Rocky Mountain oil industry during 1954." Thus summary of oil industry operations in the Rocky Mountain region is the introduction to Petroleum Information's 25th Annual Resume just published. By the end of 1954, Rocky Mountain states were producing more than half a million barrels of oil per day. This is the first time that this rate of production has been attained. The oil industry spent more than $835 million in the Rockies during 1954. A total of 4,203 new wells were drilled in the 11-state area in 1954. This included 1,503 exploratory wells, which resulted in the discovery of 172 new oil and gas pools. More than 22 million feet, 4,167 miles, of hole drilled during the year is represented by wells completed during 1954.

The Resume is a regular annual addition to the reference libraries of oil operators active in the Rocky Mountain region. It is available from Petroleum Information offices at Denver, Casper, Billings and Bismarck at $10 per copy.

To Build Ammonia Plant

The Lummus Co. has been awarded the contract to engineer and construct a 60 ton/day anhydrous ammonia plant for Westvaco Chlor-Alkali Division of Food Machinery and Chemical Corp. at South Charleston, West Virginia. The plant will obtain hydrogen from electrolytic cells.

The Lummus Co. has just recently completed construction of a nitrogen chemicals plant for Lion Oil Co. in St. Charles Parish, La. to produce 300 tons/day of ammonia, 450 tons/day of nitric acid and 500 tons/day of ammonium nitrate pellets.

New York Nomads Elect 1955 Officers

New York Chapter of Nomads' 1955 officers are, left to right, seated: Maurice F. Delano, Herb E. Maland, Steward D. Beckley, Douglas L. Grill and E. E. Anderson. Standing: Russ V. McIntire, David C. Washburn, Don E. Kircher, William E. Volkman and Norris L. Boulden, Jr.

Stewart D. Beckley of Beckley, Haltom & Hickman will head activities of the New York Chapter of Nomads as president during 1955. Other new officers are: vice president, Herb E. Maland, R. J. Eiche & Associates, Inc.; secretary, Maurice F. Delano, R. S. Stokvis & Sons, Inc.; assistant secretary, David C. Washburn, Cameron Iron Works, Inc.; treasurer, Douglas L. Grill, Link-Belt Co.; assistant treasurer, William E. Volkman, Cardwell Manufacturing Co., Inc.; sergeant-at-arms, E. E. Anderson, W-K-M Manufacturing Co., Inc.; assistant sergeant-at-arms, Don E. Kircher, Gardner-Denver Co.; assistant sergeant-at-arms, R. L. Faris, Mission Manufacturing Co.; regent, Russ V. McIntire, Baker Oil Tools, Inc., and regent, Norris L. Boulden, Jr., International General Electric Co., Inc.

Geophysical Service Changes

Geophysical Service, Inc., Dallas, Texas, which this year completes a quarter-century as a geophysical contracting firm, has announced a series of organizational and personnel changes.

Divisional changes include the promotion of Ray H. Wright and V. W. Teufel to managers of the southern and southeastern divisions, respectively. Both men were formerly supervisors in GSI's southern division. Mr. Wright will be located in Houston and Mr. Teufel in Shreveport, La.

The newly opened district offices in Midland, Texas, will be headquarters for R. H. Rainey, supervisor in the GSI mid-continent division, and Earl Thomas, southern division supervisor.

Home office changes include the transfer of E. J. Toomey and Hal J. Jones to GSI from the firm's parent company, Texas Instruments, Inc. Mr. Toomey will serve as marketing service representative and will specialize in foreign and marine contract work. Mr. Jones will serve as area geophysicist for the entire domestic area.

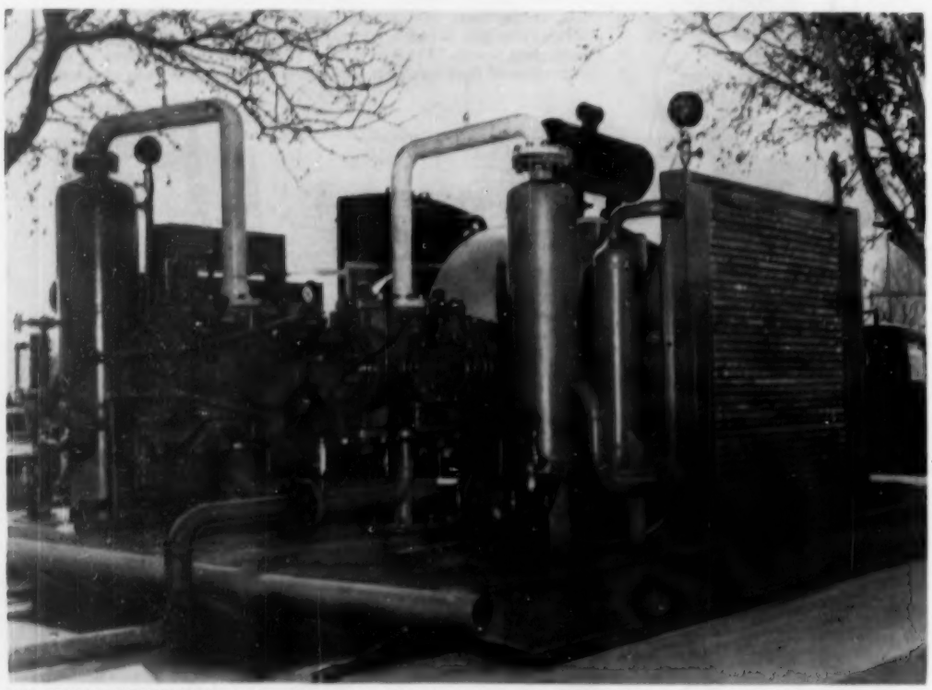
Mr. Toomey was one of the first GSI employees, having joined the firm in 1933 as a field party member. He has since been superintendent of the geophysical laboratory and senior mechanical engineer, being later transferred to Texas Instruments as chief sales engineer for geophysical equipment.

Mr. Jones joined Texas Instruments in 1952 as a senior engineer and was director of geophysical research at the time of his transfer to GSI.

Henry A. Rosenberg

Henry A. Rosenberg, oil industrialist and civic leader, died at Eccleston, Maryland, February 23 of a heart attack.

Mr. Rosenberg was president of Crown Central Petroleum Corp. He was a member of the board of Associated Jewish Charities and past president of the Sinai Hospital. He was on the management committee of the Baltimore Symphony Orchestra, as well as its former treasurer. One of his long time interests was the Boy Scout Organization and for many years he served on the executive committee of the Boy Scout Council. He was a former trustee of the Baltimore Hebrew Congregation and served in the Navy in World War I.



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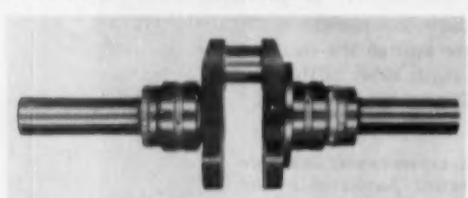

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A Mayhew shot-hole drilling rig mounted on a tractor trailer is currently being operated with payloads up to 8,000 pounds in muskeg which will not support a man on foot.

Organizes Canadian Affiliate

Panellit of Canada Ltd. has been organized as an affiliate of Panellit, Inc., Skokie, Ill. The new Canadian company will specialize in engineering, design and fabrication of industrial automatic control systems, graphic and control instrument panels and information systems.

Panellit of Canada Ltd. is located at 60 Newcastle Street, Mimico, Ont. T. A. Hislop, who was formerly associated with Canadian Industries Ltd., is chief engineer. In addition to manufacturing and warehousing facilities, the new firm supervises all Canadian sales with the assistance of Kirk Equipment Ltd. of Montreal and Toronto.

Erratum

In the map of the Denver-Julesburg Basin published in the March issue, the name Western Pipe Line Company was applied to the 625-mile line from Fort Laramie, Wyo. to Freeman, Mo. While the name Western Pipe Line Company was used in the early discussions of this new line, the name has now been dropped and the line is operated as a part of the general system of Service Pipe Line Company.

Imperial Terminal Expansion

Imperial Oil Ltd. will spend nearly $2 million on new docks and improved unloading facilities in Halifax harbor before the present year ends. The dock expansion program, which will make it possible to berth the largest oil tankers afloat, is slated for completion late in 1955.

In conjunction with these improved berthing accommodations, two new 100,000-barrel storage tanks will be installed as part of the overall refinery expansion program. Ships will discharge crude into a 24-inch line from any or all of the refinery docks to Imperial's new and existing tankage.

Executive Secretary Appointed

John W. Proctor of Edmonton has been appointed executive secretary of the Alberta division of the Canadian Petroleum Association. His headquarters are in Calgary. For the past four years he was general manager of Alberta Interfield Gas Lines Ltd.

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Transcontinental Maps $83 Million Construction Program

Transcontinental Gas Pipe Line Corp. has announced that the company will proceed immediately with an $83,000,000 unified construction program as a result of the latest Federal Power Commission order approving its plans for expansion.

The certificate just granted, coupled with FPC approval of an earlier application, will enable Transcontinental to boost its daily allocated capacity from 565 to 695 million cubic feet of natural gas and its peak day allocated capacity to 831 million cubic feet, including deliveries from storage.

The expansion program will involve 23 separate construction projects in 11 states along the line from Texas to New York. Work on all of these will proceed simultaneously, with completion scheduled for the 1955-56 heating season.

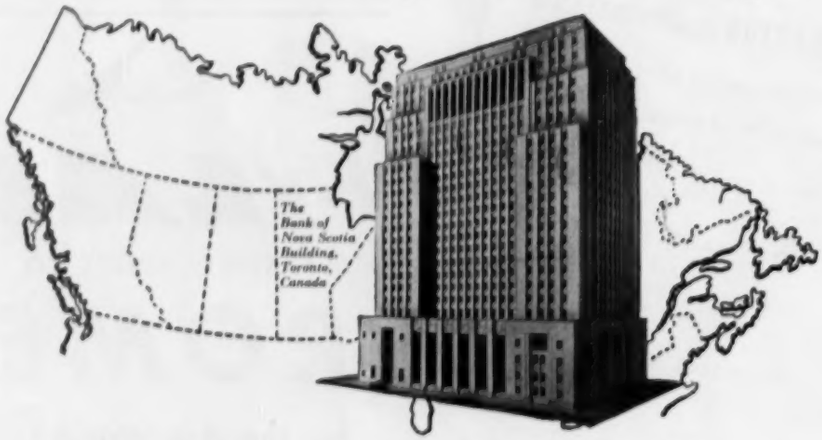
New Fluid Cracking Catalyst

American Cyanamid Co. has developed a new catalyst containing 25 percent alumina by weight, as compared with the 13 percent-by-weight alumina content normally used in synthetic cracking catalysts of this type. It has been subjected to both commercial and pilot plant evaluation since February 1952 at the Houston (Texas) refinery of Shell Oil Co. Greater efficiency and lower stock losses are claimed.

Proportional Metering

Applied Engineering Associates, Brooklyn, N.Y. have developed automatic continuous proportional metering systems for the processing of two or more liquid components in any desired range of ratios. The systems will handle all ranges of viscosity without regard to viscosity difference in components being metered.

Canada offers you opportunity



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K. Davis, Jr.

Elected President of Unit Rig

Kenneth Davis, Jr., has been elected president and a director of Unit Rig & Equipment Co. of Tulsa, manufacturers of rotary rigs and other drilling equipment. He succeeds Paul Courteney, who resigned to take a position with Westinghouse Air Brake Co.

Mr. Davis is a graduate of Texas A & M College. He was formerly associated with Great Western Drilling Co. and Loffland Bros. Co. During World War II he served with combat forces on the Italian front.

New Houdry Process

Houdry Process Corp. has disclosed that the Houdriflow catalytic cracking unit at the Sarnia, Ont., refinery of Sun Oil Co. is operating on a new basis capable of processing heavy metal-contaminated residues. The process as modified is being offered to other refiners on a license basis under the name "Houdresid."

Commercial operation of the Houdresid process at Sarnia since March 1954 has demonstrated that heavy metal deposited on the catalyst has had no significant effect on catalyst activity or selectivity.

Mechanical design of the unit is based on equipment developed in the Houdriflow moving-bed catalytic process for cracking gas oil fractions of crude petroleum. Slightly higher equipment and operating costs for Houdresid processing are more than made up by higher value of products, and payout of incremental investment is accomplished in a few months.

Sun has been charging reduced crude representing 50 percent "bottoms" from a mixture of Texas, Louisiana and mid-Continent crudes to the Houdresid unit. Approximately 64 percent gasoline is produced from the residuum, as compared with 52.5 percent motor gasoline yield from conventional vacuum distillation plus catalytic cracking.

Houdresid is the second new Houdry process to be made public recently. Houdry also announced the Houdry Iso-Plus process for the reforming of naphtha fractions into high yields of 100 octane gasoline. (WORLD PETROLEUM, April 1955.)

Helical Gear Bulletin

A new bulletin on double helical gears issued by Worthington Corp. offers information on specification, construction design, testing and various applications.

The bulletin also contains information on lubrication, diagrams, application charts listing dimensions in inches as well as illustrations of parts such as gear and pinion, sleeve bearings, oil baffles and oil pump.

Address requests for further information or copies to Worthington Corp., Advertising and Sales Promotion Dept., Harrison, N.J., specifying Bulletin No. 1958E.

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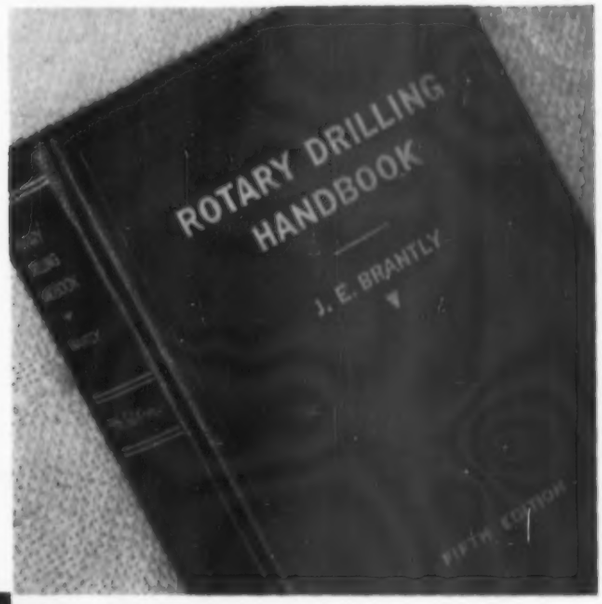

Discoveries and inventions, improved techniques and new equipment required a complete re-writing of this standard authoritative work. All tables, *filling 206 pages*, have been re-checked, revised, and expanded. New tables have been added.
A glance at the Table of Contents will show the scope of the treatment provided in this 702 page book. There are 206 pages of tables, a glossary, illustrations, charts and diagrams.

J. E. Brantly, past president, American Association of Oilfield Drilling Contractors and president of Drilling & Exploration Company, a distinguished authority on all phases of rotary drilling who has operated in most of the oil producing countries of the world, has revised all the chapters, in many cases completely re-writing them. New chapters have been added, notably one on Straight Hole Drilling by Don K. Weaver.

Other experts in some of the more highly specialized divisions have assisted Mr. Brantly in giving the most authoritative treatment this subject has ever had.

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GLOSSARY, ILLUSTRATIONS, TABLES AND FORMULAS

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Appointed to Maritime Post

James P. Patterson, retired vice president in charge of marine operations of the American Oil Co., has been appointed chairman of the Tanker Requirements Committee of the Maritime Administration, U. S. Department of Commerce. Mr. Patterson succeeds William Dunning in the post.

Wilbur Hope Cleveland

Wilbur Hope Cleveland, a world-famous oil engineer, died recently in Mexico City at the age of 86 of a heart attack.

A native of Virginia, Mr. Cleveland had resided for more than 40 years in Mexico, first as a member of the engineering staff of the Eagle Oil Company and later as an employee of Petroleos Mexicanos.

Rocky Mountain Oil Show

The Rocky Mountain Oil Show will be held June 23 through 26 at the Central Wyoming Fair Grounds, Casper, Wyo.

New Precision Indicator

A new precision indicator, the latest addition to General Electric's line of process instruments, has been announced by the company's instrument department. The instrument is designed to scan a number of process variables by the use of a manual switching arrangement on the front panel.

Designated Type HJ, the precision indicator may be used with provision for measuring up to 48 different circuits, or in conjunction with a multi-point strip-chart recorder to obtain an intermittent record.

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C. M. Saucerman

Assistant Export Manager

Clyde M. Saucerman has been appointed to the newly-created position of assistant export manager, McCullough Tool Co. He served as assistant district service manager prior to his recent appointment to the export department. Harry Hester continues as manager of the export division, whose sales volume has increased over 40 percent in the past year.

Union Oil to Conduct Shale Oil Study

Supporting the recommendation made a year ago, following a study of Interior Department activities, that the government should discontinue the pilot plant work in shale oil on which some $16 million has been spent since the close of the war, a committee of the National Petroleum Council recently made a report to Secretary McKay.

Complimenting the work done by the Bureau of Mines as "essential and valuable," the committee agreed that it had reached the point when private companies would carry on such development, as might be warranted by conditions. Therefore, the committee decided, there was no need for further government effort along the lines it had been following and it advised that activities be suspended and facilities kept in standby condition.

The forecast that private capital would carry on the study of shale oil possibilities seems now on its way to realization. President Reese H. Taylor of Union Oil Co. has announced that his company will spend $5 million on pilot plant operation in the Rifle, Colorado area where the government's work was conducted.

"We believe shale oil as a source of liquid fuel may now be competitive with domestic petroleum. Upon completion of our research and development project and providing technical and economic conditions justify it, Union Oil Co. will consider a full scale commercial operation which will require a very substantial investment."

Shell Starts Up Third UOP Platformer

The third UOP Platforming unit built for the Shell Oil Co. has gone into operation at the Shell Wood River, Ill. refinery, according to company officials.

The 16,000 b/sd unit at Wood River is processing naphtha derived from mixed crudes, which boils in the range of 190 to 360°F. The unit is producing 95 leaded octane Platformate for a motor fuel blending material.

A 5,000 b/sd Platformer is in operation for Shell at Martinez, Calif., and another of 16,000 b/sd at Houston, Texas. All were designed, engineered and licensed by Universal Oil Products Co. Procon, Inc. was the contractor on the Wood River and Houston jobs.

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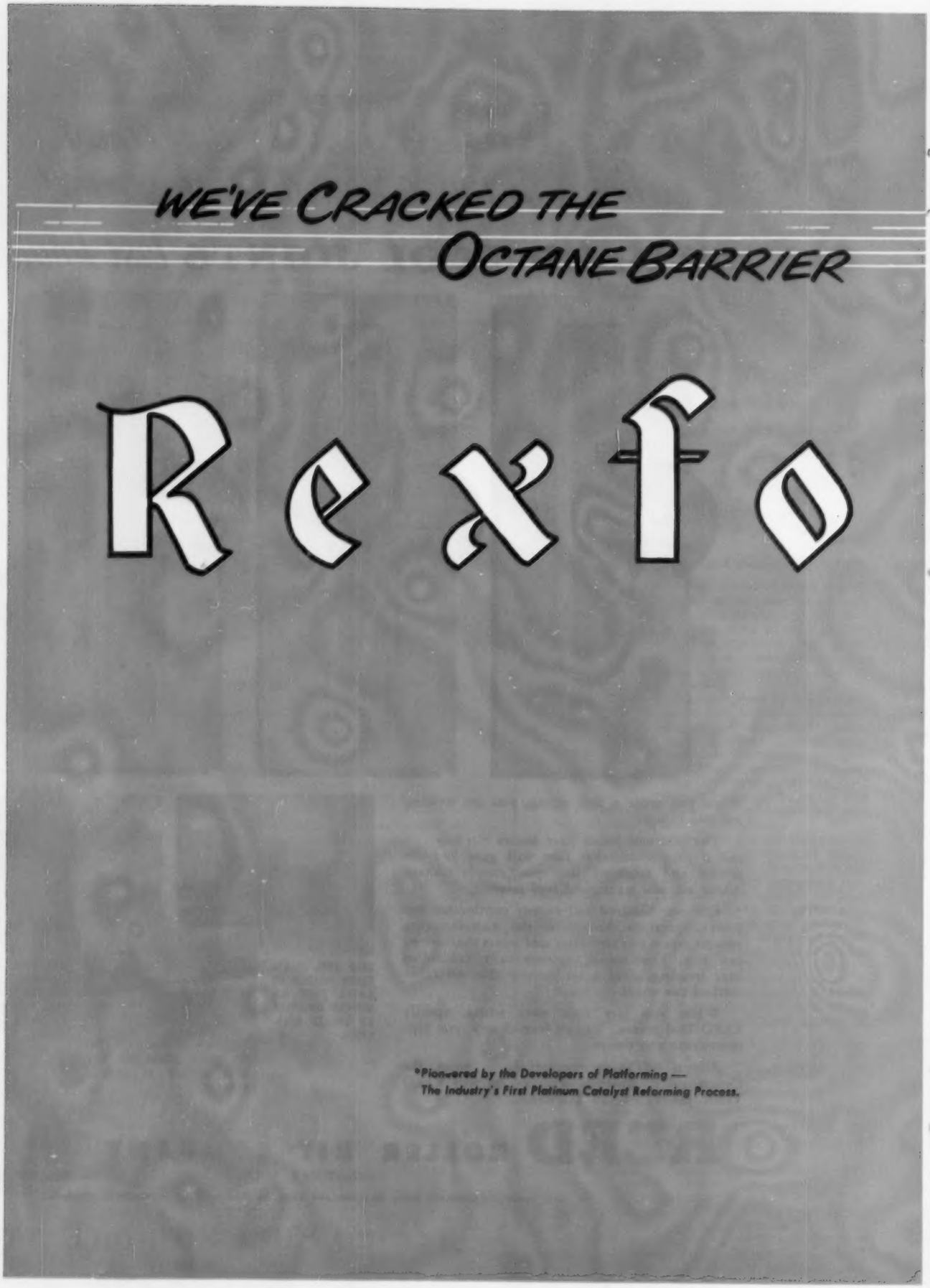
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OIL COMPANY STAFF CHANGES

EDWARD L. STEINIGER has been elected vice president of Sinclair Oil Corp. He will have charge of Sinclair's foreign crude oil exploration and production program, which now includes operations in Venezuela, Ethiopia and Italian Somaliland. Since 1950 Mr. Steiniger had been president of Venezuelan Petroleum Co., in which Sinclair Oil Corp. holds an 86½ percent interest.

Prior to the Sinclair board meeting, directors of Venezuelan Petroleum Co. announced the election of Hugh M. Russell as president to succeed Mr. Steiniger. A director of Venezuelan Petroleum Co. since 1942, Mr. Russell was vice president of that company from 1942 to 1954. Prior to his election to the presidency, Mr. Russell was assistant to the chairman of Sinclair Oil & Gas Co., the domestic crude oil producing subsidiary of Sinclair Oil Corp.

E. L. Steiniger

ALBERT E. BLAIR, chairman of the Compania Comercial Vacuum, S.A., Mexican operation of Socony-Vacuum Oil Co., announced his retirement March 2 after 24 years in that post. He will be succeeded by Howard Bird, who has been named president of the local enterprise.

Since November 1951 Mr. Bird has been general manager of Comercial Vacuum and will retain this title. He has been associated with Mobiloil since 1939, holding various positions in Lisbon and New York City, and in 1944 was appointed sales manager in Colombia.

The retiring Mobiloil leader was born in London in 1890. While attending the University of Michigan he made the acquaintance of Rauland Julio Madero, and as a result emigrated to Mexico as a solider of fortune under the colors of former President Francisco I. Madero. Later, he became a prominent figure in Mexican mining, agriculture and real-estate development, and in 1931 was put in charge of Vacuum Oil's Mexican activities. He plans to devote his future to philanthropy in that country.

H. M. Russell

ALWYN P. KING, JR., of Houston, independent petroleum and natural gas operator, is the new president of the Texas Independent Producers and Royalty Owners Association, with headquarters at Austin, Texas. He was elected at the annual meeting held March 28-29 at Fort Worth, Texas.

Mr. King succeeds Jack Woodward of Dallas, who was given a plaque on retiring and was called "a dynamic ambassador of free competitive enterprise" by R. L. Foree of Dallas, a former president.

G. Scott Hammonds of Dallas was named secretary and William T. Beard was reelected treasurer.

W. Earl Turner, formerly director of publicity, was named executive secretary to replace E. I. Thompson of Houston who is retiring to devote his time to the oil business after serving with TIPRO since its start.

J. E. HUGHES has been appointed general counsel and secretary of Shell Oil Co. of Canada Ltd. Born in New Brunswick, Mr. Hughes, prior to his coming to Shell, was for a number of years senior counsel in the Attorney General's Department of that Province. He was created a Queen's Counsel in 1952 and joined Shell in the same year as its general solicitor. In January 1953 he also assumed the responsibilities of secretary of the company. From June 1954 until his present appointment he has been on special assignment in Calgary in connection with Shell's exploration and production activities in Western Canada.

J. E. Hughes

JAMES C. PHELPS, Salt Lake City, has been made manager of development and technical advisor for Continental Pipe Line Co., with headquarters in Ponca City. Continental Pipe Line Co. is a subsidiary of Continental Oil Co.

Mr. Phelps formerly was superintendent of Pioneer Pipe Line Co., another affiliate of Continental. In his new position, he succeeds F. C. Whiteside, who recently transferred to Calgary, Alberta, to become associated with Hudson's Bay Oil & Gas Ltd., Continental's Canadian affiliate.

Also announced is the promotion of L. P. Waddell, Billings, Mont., to superintendent of Continental's communications division, with headquarters at Ponca City. He succeeds Frank E. McFarlin, who recently was appointed senior office engineer for the pipe line company at Ponca City.

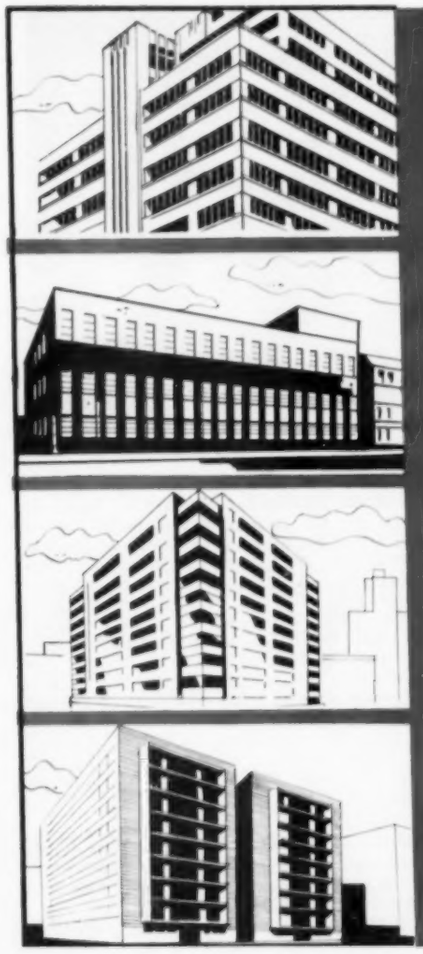
RUSSELL H. GREEN has been elected to the newly-created position of executive vice president of Signal Oil and Gas Co. Harold F. Clary, a director of Signal, has been named vice president and A. E. Stebbings was elected assistant secretary. Mr. Green first joined Signal in 1925 as vice president in charge of operations, which at that time consisted only of natural gasoline manufacturing. Under his direction, the oil producing department was established and its first wells drilled in 1928. For the past several years, his efforts have been directed solely toward the production of crude oil. Mr. Green is president of the Southwest Exploration Co., Signal's majority-owned subsidiary, and is chairman of the operating committee of the Long Beach Oil Development Co. He is a director of the American President lines.

O. H. INGRAM and **EDWARD C. MISHOU** were elected directors of Minnesota Pipe Line Co., St. Paul at the recent annual meeting. Mr. Ingram is president of Ingram Products Co., petroleum products marketing firm, with offices in St. Paul and operational facilities at Nashville and New Orleans. Mr. Mishou is general manager of the pipe line firm, which last fall completed construction of a 260-mile, 16-inch crude oil pipe line from Clearbrook, Minn. to Pine Bend, 14 miles south of St. Paul. He was formerly with the Interstate Oil Pipe Line company of Shreveport, La.

FRANK E. KALBAUGH has been appointed general manager of the newly-formed Southern Pacific Pipe Lines, Inc. He was formerly superintendent of the railroad's Salt Lake division, and has been serving with the government as general manager of the Alaska Railroad. The pipe lines of the new company will be constructed from Los Angeles and El Paso refinery areas to Tucson and Phoenix, covering a total of about 800 miles.

G. R. SCHOONMAKER, Ohio Oil's district manager at Calgary, Alberta, has been appointed assistant manager of the foreign division headquartered in Findlay. Succeeding Mr. Schoonmaker in the Canadian post is C. W. Donnelly, division geologist at Terre Haute, Ind. Stanley B. White, district geologist at Casper, Wyo., replaces Mr. Donnelly.

THOMAS F. McGAREY has been appointed manager of the asphalt sales division of Cities Service Oil Co. (Pa.). For several years he was Philadelphia regional manager for Cities Service. He will make his headquarters in New York.



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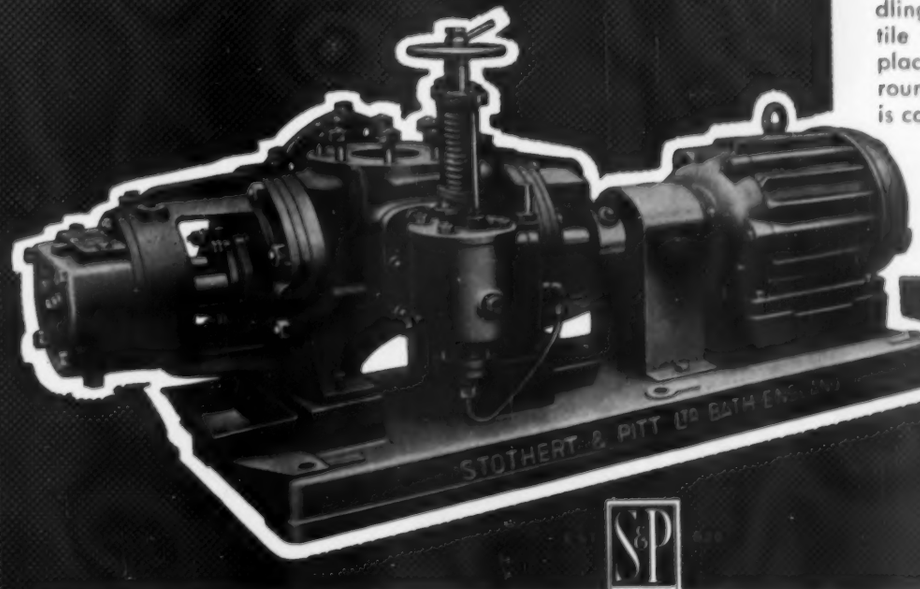

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JOHN A. MILLER, formerly southern sales manager, has been appointed assistant general manager of marketing by Esso Standard Oil Co.

Gordon D. Donald, formerly northern sales manager, has been named manager of division sales.

The positions of northern and southern sales manager have been eliminated in a realignment of the company's sales organization.

Mr. Miller has headed Esso's sales operations in the south since 1952 and Mr. Donald has been responsible for marketing operations in the northern region since 1948.

M. M. EVANS, Oklahoma City, has been promoted to regional title supervisor for Continental Oil Company's central region. Formerly a titleman in the central region land section, he will continue to make his headquarters in Oklahoma City.

JAMES W. DOWDEN, formerly geologist in Lion Oil Company's Bismarck, N.D. district office, will head the company's newly established production and exploration division office in Portland, Oregon. Mr. Dowden will serve as an observer in the northwest for Lion Oil's expanding production and exploration activities.

EUGENE H. NEWMAN, senior member of the Southern Union Gas Co., Dallas, has been awarded a diamond pin for 25 years' service. Mr. Newman started his career with Southern Union as a draftsman and surveyor in 1930, soon after the company was founded. In his 25 years with the organization he has seen it grow from 990 customers and 40 miles of pipe line to a major natural gas distributing company operating in four states, currently with over 250,000 customers and 4,468 miles of pipe line.

E. H. Newman

R. J. SCHILTHUIS has been named assistant manager of the production department of Humble Oil & Refining Co. in charge of natural gas production, casinghead gas plants, and gas transportation. He will also coordinate all sales of natural gas. Mr. Schilthuis replaces John O. Sue, who retired December 27. John J. Carter replaces Mr. Schilthuis as division superintendent of the gas division and John Yeager, gas superintendent, Louisiana division, will be acting assistant division superintendent of the gas division for a six month training assignment.

R. J. Sullivan became assistant chief engineer of the gas division on December 1, but will act as chief engineer for a six month training assignment.

GEORGE M. JONES, JR. and **EDWIN HILL** have been appointed assistant project engineers in the engineering division of the manufacturing department, Sun Oil Co.

Mr. Jones has been assigned to the electrical and instrumentation project group. He started his employment with Sun Oil in 1939 as an electrician at the Marcus Hook refinery. In 1947 he transferred to the manufacturing engineering division as a draftsman, and was promoted to engineering assistant.

Mr. Hill will work with one of the general project engineering groups. He started with Sun in 1952 as a draftsman and was promoted to engineering assistant in 1953.

E. D. BROCKETT, JR. has been elected a vice president of Gulf Oil Corp. He will be manager of the company's Houston production division, succeeding vice president B. C. Belt, who has announced his intention to retire shortly.

A petroleum engineer by profession, Mr. Brockett joined Gulf as a roustabout in the West Texas oil fields in 1934. Immediately preceding his recent appointment he had been with the company's subsidiary, Mene Grande Oil Co., in Venezuela, first as assistant to the general manager at Caracas, and later as manager of the important production operations in Eastern Venezuela.

E. LINDSAY SEMPLE of Shreveport, Louisiana, has been named vice president and manager of crude oil purchasing for the Great Northern Oil Co., St. Paul. Great Northern is building a $25 million refinery at Pine Bend, fourteen miles south of St. Paul.

Mr. Semple will be located at Regina, Saskatchewan, where he will immediately establish an office which will handle the crude oil purchases of Great Northern.

D. F. EDWARDS has been named general superintendent by Esso Standard Oil Co. at its Bayonne refinery. He succeeds Bill Wadt, who has been named assistant to the manager of the New York sales division. Warren C. Wilson, assistant general superintendent at Bayway refinery, has been moved to Bayonne as assistant general superintendent, the position formerly held by Mr. Edwards.

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E. S. Bleecker

Gulf Personnel to London Office

Five Gulf staff members from New York and Pittsburgh have been transferred to Gulf Oil Corporation's newly-established London division production office, C. W. Hamilton, vice president in charge of the London office, has announced. They are: E. S. Bleecker, exploration coordinator; R. W. McClenahan, concessions coordinator; E. E. Ferrin, production coordinator; S. O. Gasperina, finances and services coordinator; and Gus Pyre, staff assistant to Mr. Bleecker.

Mr. Bleecker joined Gulf as a geologist with the South American Gulf Oil Co. in 1919, became chief geologist of the Venezuela Gulf Oil Co. in 1926, was transferred in 1931 to the foreign production office in New York as staff geologist, and from 1946 to 1949 served as executive assistant in that office. He was appointed manager of western hemisphere operations, foreign production division, in 1949 and became manager of eastern hemisphere operations in 1951.

Mr. McClenahan came to Gulf in 1948 as staff assistant to the vice president, production department, and in 1950 was transferred to the executive department as a staff assistant.

Mr. Ferrin joined Gulf in 1930 in the Houston production office and in 1947 went to the Middle East as chief petroleum engineer and production superintendent of the Kuwait Oil Co. In 1949 he was transferred to the foreign production office in New York, where he has been executive assistant to the manager of eastern hemisphere operations and later technical advisor to the vice president.

Mr. Gasperina joined Gulf with the New York sales division in 1923. He was appointed assistant manager, accounting department, in 1944.

Mr. Pyre came to Gulf as a geologist with the Mene Grande Oil Co. in Venezuela in 1937. He was transferred to the foreign production office in 1946, and in 1951 went to the Danish American Prospecting Co. in Copenhagen, Denmark as branch manager and chief geologist. In early 1954 he returned to the New York office to handle special assignments.

Book Review

Materiels d'Equipement pour l'Industrie du Petrole (Materials and Equipment for the Petroleum Industry); published 1955 by Revue Française de l'Energie, Paris; 480 pages; 2,500 French francs.

This is a composite catalog of the associated French manufacturers of petroleum equipment. Several hundred firms are represented. Most of the entries present technical descriptions of materials available from the manufacturers, specifications, and members of the association, a classified list of materials (with English translations) with reference to the fabricators concerned, a repertory of patents, licenses and trade marks, an English-French lexicon of the most usual technical words utilized in the oil industry, and a series of conversion tables of American, British and metric units.

Chemical Flocculation of Refinery Waste

Proportioneers, Inc. has reprinted an article on chemical flocculation of refinery waste in the form of an applications manual on petroleum refining. This 16-page reprint is available on request from Proportioneers, Inc., 345 Harris Ave., Providence, R.I.

Assistant Export Manager

Clyde M. Saucerman has been appointed to the newly-created position of assistant export manager, McCullough Tool Co. He served as assistant district service manager prior to his recent appointment to the export department. Harry Hester continues as manager of the export division, whose sales volume has increased over 40 percent in the past year.

Microwave Engineering Guidebook

A 51-page "engineering guidebook" to the proper selection and arrangement of RCA microwave radio relay equipment for point-to-point communications in a host of applications over distances up to one thousand miles has been announced by the engineering products division, Radio Corp. of America, Camden, N. J.

Tri-Clad Motors Bulletin

A full-color publication, GEA-6153, describing new Tri-Clad "55" motors and a new starter for oil-well pumping applications is available from the General Electric Co., Schenectady 5, N.Y. The bulletin covers motors from 1 to 30 hp, and new oil-well pumping starters.

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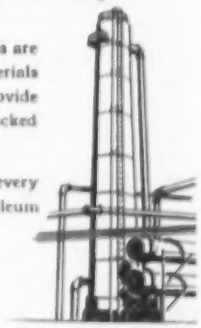

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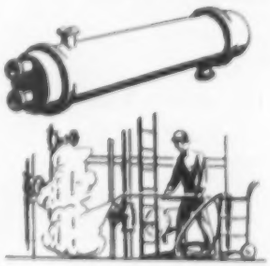

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INTERNATIONAL NEWS AND NOTES

Company Organization Completed in Iran

Under the agreement completed several months ago between the government of Iran and the Consortium of international companies organized to manage the oil properties formerly directed by the Anglo-Iranian Oil Co. Ltd., each of the operating companies was to have seven directors including two appointees of the government. The second of these directors for each of the companies has now been selected. For the exploration and producing company the appointee is Rahmatollah Ghavani, who was educated in India and at the American college in Teheran. He joined Anglo-Iranian in 1929, was transferred to Abadan in 1939, and subsequently served as field manager at Masjid-i-Suliman until 1950, when he resigned.

The appointee to the directorate of the company operating the Abadan refinery is Mahmod A. Poozeshi. He entered the service of Anglo-Iranian in 1925 in Teheran. He later completed an engineering course at Loughborough College in the United Kingdom and returned to Abadan in 1939 as maintenance engineer in the distribution department. Later he was district engineer for Anglo-Iranian in Teheran. In 1951 he was appointed chief engineer at Abadan for the National Iranian Oil Co.

Production of crude oil in February was 973,000 tons, an average of 263,000 barrels per day, bringing the total since the first of the year to 1,902,000 tons. Refinery throughput in February was 614,000 tons, a daily average of 167,000 barrels, making the total for the first two months of the year 1,228,000 tons.

More units at Abadan are coming into production. The lubrication plant is turning out a full line of lubes. The catalytic cracking and alkylation units will not be in operation until near the end of the year.

Determination of a new basic wage scale, a matter that has been under negotiation for some time, has been decided upon. The minimum pay for unskilled workers is 83 reals ($1.33) per day. This is an advance over the old basic minimum plus various allowances. Payments to other workers depend upon the degree of skill required by their jobs. About half receive an allowance of 70 percent above the basic rate, while the others draw pay at 70 to 100 percent above the basic scale. The Consortium companies continue to import large quantities of foodstuffs and other commodities which are sold to workers at low prices, thereby assuring ample supplies and avoiding the risk of black marketing.

Discovery Well in Brazilian Interior

In a statement made public by Helio Beltrao, managing director of Petrobras, it was announced that the wildcat well drilling at Nova Olinda on the Madeira River, 100 miles southeast of Manaos on the Amazon, was brought in as a producer on March 13. Oil was found at a depth of about 8,000 feet and was a light crude of between 40° and 50° API. A preliminary test showed a flow of about 600 barrels daily.

It is pointed out that this is the first important oil production in Brazil outside the state of Bahia, where small fields have been in operation with a present production of 6,000 barrels daily for several years. The Madeira River, near which the discovery is located, is an affluent of the Amazon approximately 1,000 miles from the Atlantic, both waterways being navigable for the entire distance.

The Amazonas district has long been regarded by geologists as the most promising area in Brazil for oil exploration, but the fact that its vast area of 500,000 square miles is unexplored jungle has delayed any attempt at development until now.

Australia's Largest Refinery Commissioned

Australia's biggest oil refinery was commissioned February 1 when the first distillation unit at Kwinana refinery, built in western Australia by companies associated with the British Petroleum Company Ltd., began operating more than three months ahead of schedule. The remaining units will be brought into operation during the next two months.

Started just over two years ago, the new $84 million refinery will process about 60,000 barrels a day of crude oil brought by tanker from the Middle East.

The refinery will be operated by one of British Petroleum Company's Australian associates, Australasian Petroleum Refinery Ltd. Construction was supervised by Kellogg International Corp., a subsidiary of M. W. Kellogg of New York.

Greek Refinery Contract Awarded

Prime Minister Papagos has announced the selection of Hydrocarbon Mineralol GmbH of Dusseldorf, Germany, as the successful bidder for the design and construction of a 30,000 barrel oil refinery to be erected in Greece. The refinery will be the property of the Greek Government.

George Armistead and Co. of Washington, D.C., consulting engineers and technical advisors to the Greek government, assisted in the evaluation of contractors' bids and specifications of design features.

No decision has been announced as to the operator of the refinery. It is understood that oil companies presently marketing in Greece are interested in obtaining the operating contract with certain privileges concerning importation of crude supplies.

Second German Platformer On Stream

Western Germany's second UOP Platforming unit has been placed in operation in the refinery of the Gelsenberg Benzin A.G.

The startup of the 7,100 barrel per day plant represents an important step on the way to realization of a comprehensive enlargement and modernization program for the refinery. Mixed Aramco raw oils and hydrogenated gasoline are treated in the Platformer. An end product with a base octane No. (ROZ) of 85 is obtained, which is used as blending component for producing a high grade finished gasoline.

Planning and starting of operation were carried out by Universal Oil Products Co., which also licensed the plant. Procon (Great Britain) Ltd. and Lurgi Gesellschaft für Warmetechnik built the plant.

Natural Gas Strike In Israel

The discovery in Israel of the first natural gas deposit which may have commercial possibilities has been confirmed by officials of the Israel-American Oil Corp. which made the find near the industrial area of Petah Tiqva three and a half miles northeast of Tel Aviv.

Louis Franklin, president of Israel-American, reported from Jerusalem a "significant" gas occurrence in shallow sands at a depth of about 600 feet while crews were core drilling to test geological formations in connection with the company's oil exploration activities.

Mr. Franklin said the deposit "may have commercial possibilities provided sufficient reserves can be established."

Formosan Wildcat Discovers Gas

The Chinese Petroleum Corporation's Shantzuchiao wildcat well, located in northern Formosa near Taipei, has produced an estimated 300,000 cubic feet of gas per day on test through 1½-inch choke with casing perforated by six shots at a depth of 870 to 874 feet. The gas comes from a 33-foot thick sandstone member of the basal Miocene Wuchishan formation. The well is slated to go to a total depth of 5,000 feet, so that no further perforations and tests were made before drilling was resumed. The entire thickness of the sandstone member is believed to be productive, so it is reasonable to assume that if the whole section were opened the daily production would be considerably greater than that produced through only six perforations in a 4-foot interval.

The well is being drilled by the government-owned Chinese Petroleum Corp. with the technical assistance and financial help of the United States Foreign Operations Administration's mission. It is a test of the previously undrilled Shantzuchiao anticline whose subsurface is composed of basal Miocene formations never before penetrated by the drill. Therefore, the shallow gas discovery is substantiating evidence that the anticline is a favorable trap for gas or oil.

The Shantzuchiao anticline forms a mountain about 1,000 feet high at the outermost edge of the northwestern foothills belt of Formosa. It trends northeast-southwest an overall length of about 5½ miles, is 3½ miles wide, and like most foothills structures, is complicated by faulting. Other faults found in the area are minor and presumed to have no effect on the structure as an oil and gas trap. The surface rock at the well site is the basal part of the lower Miocene, lower coal bearing formation, the base of which was reached in the well at a depth of 587 feet. The underlying Wuchishan formation is the oldest known Miocene in Formosa and it was in a sandstone bed 283 feet below the top of this formation that the production test was run and gas revealed.

The maximum thickness of the Wuchishan formation found in outcrop section is about 2,000 feet, but the base of this section is in thrust fault contact with younger rocks so that total thickness is unknown. The well at Shantzuchiao may or may not penetrate the entire Wuchishan formation before the plane of the thrust fault under that fold is reached at an estimated depth of 5,000 feet. Below the thrust fault younger beds are expected to be encountered of unknown structural relationship so that deeper drilling is not anticipated.

Spudding in of Shantzuchiao wildcat in Formosa which discovered gas.

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German Refinery to Build Houdriformer

Contracts have been awarded for installation of a Houdriforming unit, including a Houdry guard case pretreating section, at the Gewerkschaft Erdoel-Raffinerie Emsland refinery in Lingen, Germany. The Houdriformer will be of 3,500 b/d capacity for production of high-octane motor gasoline. The Lummus Co. Ltd. of London will handle overall engineering and construction of the plant based on process designs by Houdry Process Corp. The Emsland refinery now has in operation a 17,500 b/d Houdriflow catalytic cracking unit, processing a mixture of nearby German crudes.

Sylhet Oil Test Drilling

A test well is being drilled by Pakistan Petroleum Ltd. at Haripur, five miles from Sylhet town. Recent depth was 4,000 feet.

Middle East Crude Oil Production

The following crude oil production figures for the month of February 1955 are announced:

	FEB. 1955 LONG TONS	YEAR 1955 LONG TONS
Iraq Petroleum Co. Ltd. (Kirkuk field)	1,791,103	3,780,962
Basrah Petroleum Co. Ltd. (Zubair & Roumaila fields)	510,483	968,675
Mosul Petroleum Co. Ltd. (Ain Zalah & Butmah fields)	99,549	204,375
Qatar Petroleum Co. Ltd. (Dukhan field)	407,367	812,814
Kuwait Petroleum Co. Ltd.	4,109,970	8,354,713
Aramco (25,848,108 U. S. Barrels)	3,492,987	7,324,089
Iran	973,000	1,902,000

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Seek to Join Iran Consortium

At the time when the agreement for operation of the Iranian oil industry was concluded between the government of Iran and a group of international oil companies in October 1954, it was announced by the American members of the group that independent oil companies of the United States would be welcome to participate in the American share of the undertaking on the same terms as the original members.

The five American companies included in the original agreement, Standard Oil (N.J.), Gulf Oil Corp., Socony-Vacuum Oil Co., The Texas Co., and Standard Oil Co. of California, hold a 40 percent interest in the Iran operation or eight percent for each company. Anticipating that very few companies would be interested, representatives of the five companies in conjunction with the State Department set up a procedure by which five percent of their holdings would be made available for this purpose.

Actually 11 companies filed applications with requests for a total 36 percent interest in the operation. The applicants with the percentages they wished to acquire were as follows:

Anderson Pritchard Oil Co.	1%
Atlantic Refining Co.	2%
Cities Service Oil Co.	5%
Hancock Oil Co.	3%
Pacific Western Oil Corp.	5%
Richfield Oil Corp.	5%
San Jacinto Petroleum Corp.	1%
Signal Oil and Gas Co.	3%
Sinclair Oil Corp.	3%
Standard Oil Co. (Ohio)	3%
Tide Water Associated Oil Co.	5%

In view of the extent of the applications, it is obvious that some adjustments must be made and it is considered likely that some of those who have filed requests may withdraw them.

Sui Gas Line Nears Completion

Construction of the pipe line built to deliver natural gas from the Sui field in Pakistan to the capital at Karachi has been progressing ahead of schedule and the line is expected to begin delivery of gas to consumers by or before the target date of August 1. The initial rate of supply is estimated at 37 million cubic feet per day, rising progressively to three times this quantity.

In addition to the main line, approximately 50 miles of additional lines ranging from 2-inch diameter up to 16-inch will be laid to deliver gas to industrial consumers.

The question of taking gas from Sui northward to Kot Adu and beyond for the generation of electricity is under consideration. The Pakistan Industrial Development Corp. is sponsoring a million-kilowatt power station at Kot Adu.

An encouraging development is the showing of gas in the Uch test on the anticline of Bugti-Marri at 4,000 feet reported by Pakistan Petroleum Ltd. on April 1. It is planned to continue drilling to a depth of 10,000 feet if no oil bearing strata are met earlier.

Several large international companies are showing interest in joining oil exploration in West Pakistan and have applications for concessions pending.

Socony to Explore in Portugal

With the recent signing of an agreement in Lisbon, Socony-Vacuum Oil Co., Inc., has undertaken the direction of exploration in Portugal as contractor, with a participating interest in the benefits of a concession held by Companhia dos Petroleos de Portugal. The latter company is mainly owned and financed by the Portuguese Government and the Axel Johnson interests of Stockholm.

The Socony-Vacuum undertaking will be conducted in the name of the recently founded Delaware subsidiary, the Socony-Vacuum Exploration Co., with offices in Lisbon.

The local manager is L. H. Porter and chief of exploration is Forrest Wimbish, both of whom have been transferred from Magnolia Petroleum Co., southwest affiliate of Socony-Vacuum.

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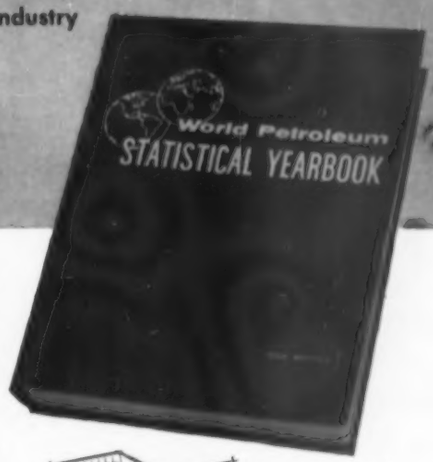

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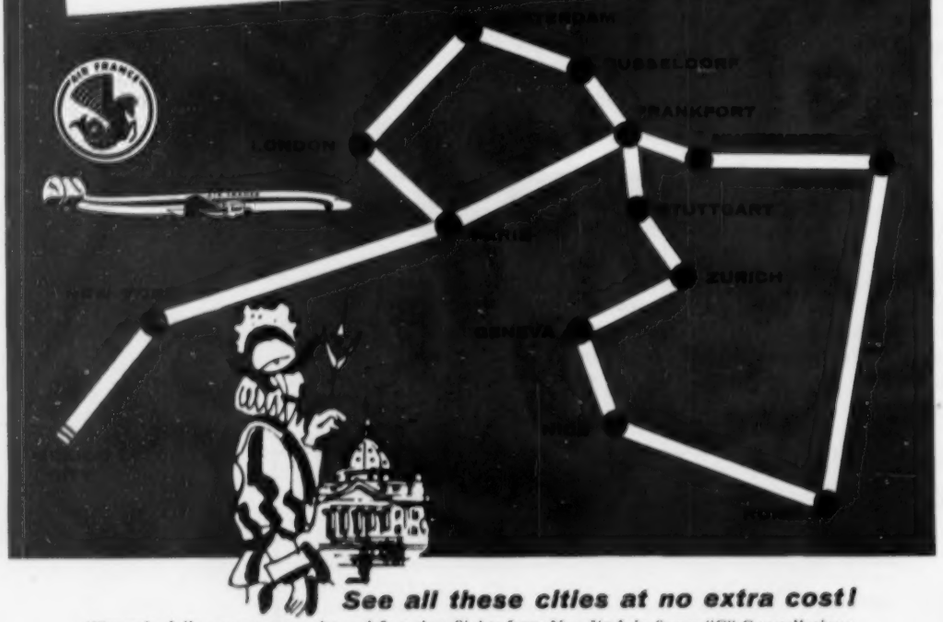

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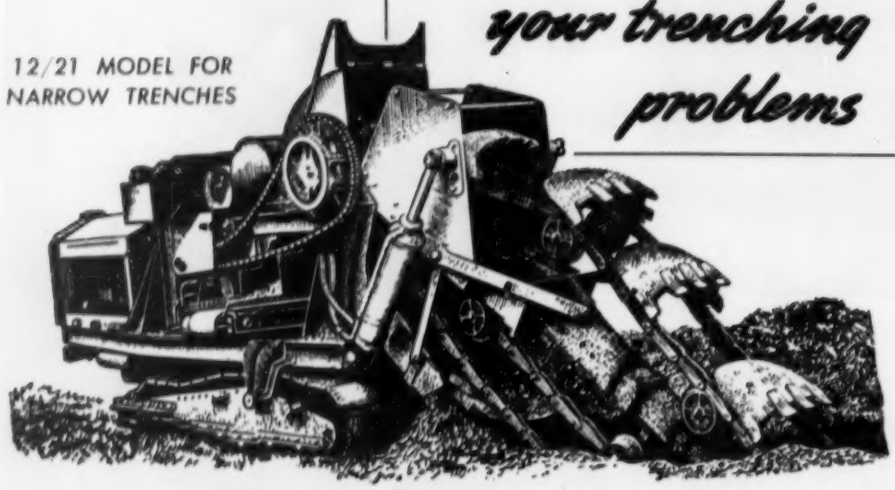

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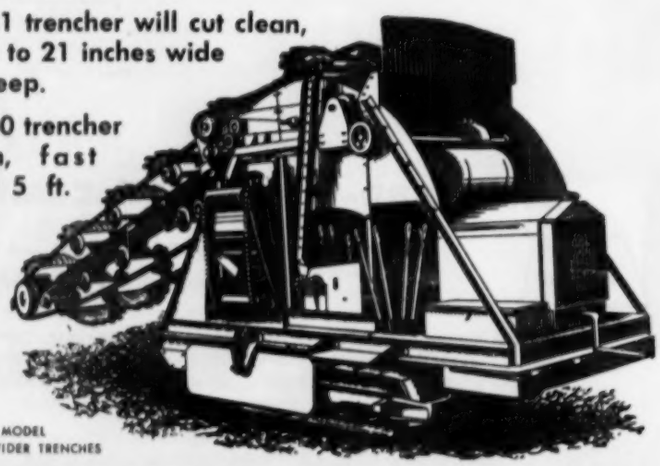

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